BUCKINGHAM TOWNSHIP

WATER AND WASTEWATER STANDARDS

Prepared for
Buckingham Township
PO Box 413
Buckingham, PA 18912

REVISED February 22, 2023

Prepared by

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RESOLUTION NO. 2595

A RESOLUTION OF THE BOARD OF SUPERVISORS OF BUCKINGHAM TOWNSHIP, COUNTY OF BUCKS, REPLACING RESOLUTION NO. 2574 ADOPTING WATER AND WASTEWATER STANDARDS

BE IT HEREBY RESOLVED and it is hereby RESOLVED AND ENACTED by the Board of Supervisors of the Township of Buckingham, County of Bucks, that the WATER AND WASTEWATER STANDARDS dated February 22, 2023 be Approved and Adopted.

RESOLVED and ENACTED this 22nd day of February, 2023.

BUCKINGHAM TOWNSHIP
BOARD OF SUPERVISORS

Paul Calderaio, Chairman

Maggie Rash, Vice-Chairman

Jon Forest, Member

ATTEST:

Dana Cozza,
Township Manager

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DIVISION 0

DESIGN STANDARDS

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SECTION 00001

SEWER COLLECTION SYSTEM DESIGN GUIDELINES

I. SCOPE

A. It is the intent of this "design guidelines" section to provide sufficient detailed information to enable the Engineer for the Owner/Developer to correctly and efficiently design the overall sewer system for a particular development. If there is a question or a concern regarding the design of any portion of the collection system that is not adequately answered within this chapter or the Specifications, the owner/developer or his representative shall call the Engineer to get all issues resolved prior to design. Any deviation from these STANDARDS AND SPECIFICATIONS must be approved in writing by the Engineer.

B. Design Calculations

1. General

Upon request, the Developers Design Engineers shall submit design data and calculations to the Township who will forward them to the Engineer. All information shall be submitted on 8 ½" x 11" reproducible sheets, bound in a folder satisfactory for filing, and labeled for identification by title and project number.

2. Data

Following is a list of the data which may be required by the Township to evaluate the impact the proposed project will have on the Township's sewer system:

- Alternative alignment analyses
- Present worth analysis comparing alternatives
- Drainage Area studies for pumping stations and gravity sewers.
- Wastewater flow projections
- Projected velocities and pressures within pipelines

II. COLLECTION AND INTERCEPTOR SEWERS

A. Adequate Sewer System Capacity

1. The flow rate which the sewer pipe/manhole system can accommodate utilizing the available hydraulic gradient in the system shall be considered the sewer system capacity.

2. Available hydraulic gradient in lateral and collection lines shall be an elevation not greater than 80% of the pipe diameter above the pipe invert.

3. Available hydraulic gradient in an interceptor sewer line shall be an elevation that will not interfere with service connections or collection lines.

B. Location

1. In New Subdivisions. Manholes shall be located within the pavement area wherever possible, In the center of the road but not less than three feet (3') from the face of the curb and cone section of manhole rotated away from face of curb. Manholes shall not be located within designated parking areas within townhouse and condominium subdivisions. Whenever a sewer service drainage area adjoins a future service area, the sewer system shall be extended to the property line of the future service area. Sewers shall be extended beyond the edge of paving by means of a manhole for future phasing of the development.

2. In existing developments with curbs, sewer location shall generally be the same as in new subdivisions. The location of other existing and proposed utilities shall be fully considered.

3. In existing developments without curbs, Collecting Sewers shall generally be located three feet (3') outside of the edge of pavement, except that the sewer shall not be located under a future curb. The location of other existing and proposed utilities shall be fully considered.

4. In Parks. Easements, and Public Right-Of-Way. Where location of sewer would require removal of or damage of trees within parks or right-of-way, design engineers shall obtain approval of the Township, for sewer alignment and trees to be removed. Intercepting sewers shall generally follow streams or the valley of a drainage area. They shall be located so as to best serve the drainage area. Special precaution is required to insure the proper location and elevation of manholes for future connection of collecting sewers.

5. Sewers Adjacent to Buildings. Sewers shall be located a minimum of fifteen feet (15') away from existing or proposed buildings.

6. Sewers Crossing Waterways. Sewers crossing waterways shall be placed a minimum of three feet (3') below bottom of waterway (measured from bottom of waterway to top of pipe), unless otherwise approved by the Township. Generally, all sewers crossing waterways shall be encased

in concrete, a minimum of 6-inch thickness. Limits of concrete encasement shall extend from top of bank to top of bank. The entire manhole run which passes through the concrete encasement shall be constructed of Cement-lined Ductile Iron Pipe. The design shall incorporate restoration with rip-rap placed from bottom of stream to top of bank where approvable by PADEP. Based upon projected stream velocities, the Engineer shall calculate the size and limit of the rip-rap and this information shall be shown on the construction drawings. Rip-rap shall be sized to prevent movement from flooding events.

7. Sewers and Storm Water Management Locations. Sewer line shall not be located within the embankment of the pond, spillway, outfall channel, fenced in area or any part of the storm water management facility. Storm water management facilities shall include but not be limited to storm water management ponds, water quality traps, underground storm water management facilities, rain gardens, and storm drains.

8. Sewers within Pa. Dept. of transportation (Penn DOT) Right-of-Way: Sewers may only be located within the State Highway Right of Way with a permit from Penn DOT. If allowed, the design of sewer lines shall take into consideration future horizontal and vertical roadway improvements that would likely occur.

9. Sewers within Township Right of Way: The design of sewer mains shall take into consideration of future horizontal and vertical roadway improvements that would likely occur.

10. Sewers Located Within 100 Year Flood Plain. The 100 year flood plain elevation shall be designated on the plan and profile. Manholes shall be extended above the flood line where possible and bolt-down waterproof lids installed

11. Minimum Length of Extensions. All collector and interceptor sewer extensions to serve a development or petition project shall be constructed to the most distant property line of the property or petition areas being serviced accessible by gravity, with a terminal Manhole installed.

12. Sewer main alignments shall not be located within existing or future wetland mitigation areas or reforestation areas.

13. Sewers Adjacent to Streams. The design of sewer mains longitudinally adjacent to streams shall consider locating the alignment away from the outside meander bend of the stream. The distance of the sewer from

the stream bank shall be sufficient to account for stream bank erosion over the life of the pipe.

C. Quantity of Sewage Flow. Collecting and Interceptor Sewers shall be designed to carry the flow for the present and future population within the current land use plan.

1. Average Sewage Flow. Average Sewage Flow is the sum of:

a. Houses in area by house count and reference to Section II of the Land Based wastewater Disposal Guidelines.

b. Apartment and Townhouse units in area presently developed or being developed and reference to Section II of the Land Based wastewater Disposal Guidelines.

c. Institutional, commercial and industrial establishments. Average Sewage Flow (exclusive of industrial wastes) shall be determined from a study of the establishment, or the rate of 1200 gallons per day per acre shall be utilized, whichever is the greater.

d. Allowance shall be made for vacant lots and adjoining sewer service areas in accordance with zoning regulations and engineering judgment.

2. Infiltration and Inflow. Infiltration and inflow shall be determined by tributary area in acres by the rate of 400 gallons per acre per day or an additional allowance of 40 gallons per capita per day (gpcd) using the latest U. S. Census data for the Township, whichever is the lesser.

3. Peak Flow. Peak flow shall be as specified in the Pennsylvania Department of Environmental Guidelines.

4. Design Flow. Design flow shall be as specified in the Pennsylvania Department of Environmental Guidelines.

D. Size

1. Accepted sizes for collector and interceptor sewers shall be eight inch (8”), twelve inch (12”), fifteen inch (15”), eighteen inch (18”), twenty-one inch (21”), twenty-four inch (24”), thirty inch (30”) and thirty-six inch (36”) diameters.

2. The size of the sewer shall be sufficient to carry the previously discussed Design Flow when flowing 80% of the pipe diameter above the invert. Size shall be determined by the relationship Q=AV, where:

Q = quantity of sewage in cubic feet per second (cfs) (design flow)

A = required cross sectional area of conduit in square feet

V = velocity in feet per second

Velocity shall be determined by the Manning Formula

$$V = \frac{1.486}{n} \times r^{2/3} \times s^{1/2}$$

n = coefficient of roughness, "n" shall not be less than 0.013.

r = hydraulic radius – cross-sectional area divided by the wetted perimeter

s = slope in feet per foot

All sewers shall be designed and constructed to have at least the minimum slopes for the specified sites in accordance with PADEP Guidelines.

E. Clearances – (Sewers Crossing Below Water Main) – Clearance shall be measured between outside of pipes. Where specified clearance cannot be met, sewer pipe shall be encased in concrete ten feet each side of water main. For sewers crossing water mains, sewers shall have a minimum vertical clearance of eighteen (18) inches. For sewers parallel to water mains, if sewer and water main are less than 10 feet apart, sewer shall be 6 feet below water main. If greater than 10 feet apart, sewer shall be below water main. If a sewer can not cross below the watermain, special design considerations will apply as directed by Engineer.

F. Material and Size of Pipe – Sewer mains, collectors, and interceptors shall conform to the Standard Specifications and/or approved contract specifications and be in accordance with the latest approved material list. PVC pipe may be allowed up to 24-inches in diameter.

G. Depth – The maximum depth of sewer is fifteen feet (15') without prior Township approval. The design of excavations below fifteen feet shall be in accordance with applicable Local, State and Federal safety regulations. The minimum cover over sewer main shall be 3'-6" unless otherwise approved by the Township.

In all cases, sewer depth shall be sufficient to meet Township Code for house connection's depth, grade and clearance.

H. Anchorage – Sewers on 20 percent slopes or greater shall be anchored in accordance with the following schedule.

Grades 20% - 35%

20 ft. length pipe – Anchor at each joint

13 ft. length pipe – Anchor at every other joint

Anchor spacing shall not exceed 36 ft.

Grade 35% - 50%

20 ft. length pipe – Anchor at each joint

13 ft. length pipe – Anchor at each joint

Anchor spacing shall not exceed 24 ft.

Grades > 50%

Custom Design

Anchor spacing shall not exceed 16 ft.

I. Appurtenances

1. Manholes. Manhole details are shown in the Standard Details. The Designer shall use these standards as required to meet the design situation and shall designate the type on the contract drawings.

2. A sampling manhole shall be provided for all lots zoned Commercial at the time of utility construction for the subdivision. Previously developed or subdivided lots that do not already have sampling manholes shall have sampling manholes installed at the time of development or re-development.

3. Maximum manhole spacing shall be 400 feet.

4. Manholes located within the 100 year flood plain shall extend three (3) feet above existing grade or above the 100-year flood line, whichever is greater, and shall be constructed with watertight frame and covers.

5. A PVC insert dish with bottom drain shall be installed within all manholes that have a possibility of being submerged. The Construction Drawings shall indicate those manholes that shall receive the PVC insert dishes. Additional dishes may be required in response to final field conditions. If a dish is proposed, then a watertight frame and cover is not required.

6. The edge of manhole frames and covers shall be located a minimum of six (6) inches from the gutter pan.

7. Generally, manholes located within paved and mowed areas shall be constructed to proposed finish grade. Generally, manholes located within open space areas shall be a maximum of three and one-half (3.5') feet and a minimum of two and a half (2.5') feet above existing grade.

8. Manholes located within an Open Space Area shall be constructed with a locking frame and cover.

9. Manholes shall be placed where waterways are not likely to change direction or erode the area around manhole.

10. The minimum inside diameter of manholes shall be four feet (4'-0") for sewers less than twenty-four inches (24") in diameter. For sewers twenty-four inches (24") and larger the inside diameter shall be increased to five feet (5'-0"). For built in-place manholes the minimum inside diameter shall be four feet (4'-0") for sewers less than eighteen inches (18") in diameter. For sewers eighteen inches (18") and larger the base section shall be increased to five feet (5'-0").

11. Where approved, manholes over fifteen (15) feet deep shall have a five foot (5') inside diameter, from invert to cone section, regardless of the inflow and outflow size of the sewer in accordance with the Standard Specifications and Details.

12. Manholes shall be used at changes of pipe size, grade or alignment. A minimum drop of one-tenth foot (0.10') shall be used at manholes.

13. Terminal manholes shall be constructed at the end of all sewers. A maximum of four sewer service connections shall enter a terminal manhole. A maximum of two sewer service connections shall enter line manholes.

J. Structural Considerations

1. Tunnels and Sleeves. Sewer lines under State roads or Township roads as required shall be installed in a tunneled or jacked sleeve as required by the Penn DOT or Buckingham Township. Ductile iron pipe shall be used for the entire manhole run in applications where a tunnel or sleeve is required with the manhole run. Sewer lines and sleeves under railroads shall be designed according to specifications of the railroad being crossed. Manholes shall not be any closer than ten feet (10') from both ends of sleeve

K. Connection to Existing Manholes

a. Existing manholes to which connections are being proposed shall be rehabilitated as required so that they conform to current standards of the Township. At a minimum, existing manholes that are modified by new connections shall be watertight and structurally sound. Coring method and proposed gasketing shall be noted on the construction drawings.

III. SERVICE CONNECTIONS

A. Unless otherwise approved, one sewerage service connection shall be allowed per lot.

B. Location – If type of dwelling unit changes after design approval, then sewer service connections shall meet standards of proposed type of dwelling unit. House connections shall be built to the sewer main for all lots within proposed developments. All adjacent improved lots which are not a part of the proposed development but which may be served by the sewer line shall be shown on the Drawings. Connections for these lots shall be shown where and as directed by the Township. Clean outs shall not be located any closer to buildings than depth of service at clean out and shall be located within a drainage and utility easement or a public right-of-way. Service connections shall not be located within sidewalks, driveways or steps. Sewer services placed within a paved area for non-residential uses shall have a lamp hole frame and cover placed over the clean-out in accordance with the standard details. Clean out shall be located at the edge of easement or right-of-way. Public sewer services shall not be oriented to allow the service connection to pass through storm water management facilities.

C. Type – Connections for the various types of units shall be as follows:

1. All Township service connections within the public right-of-way shall be owned by the property owner. Work on the portion of the connection (lateral) shall require Township permission and the appropriate road opening permit and/or restoration of easements.

2. Single Family Detached – Individual sewer services.

3. Single Family Attached – Individual sewer services.

4. Townhouse Condominium – Individual sewer services.

5. Multi-family (Apartments) – Sewer service to the sewer main with private on-site sewers unless public sewers are required to traverse the property to serve adjacent parcels.

6. Multi-family (Apartment-Style Condominiums) – Individual sewer services to each building. On-site lines may be publicly owned only if system configuration provides service to adjoining properties.

7. Commercial – Sewer service to the sewer main with private on-site sewers unless public sewers are required to traverse the property to serve adjacent parcels.

8. Twin house connections will not be permitted.

9. Flag Lots – Individual sewer service connections shall extend to the sewer main, unless otherwise approved by the Township. The publicly owned sewer system may extend with the flag lots if the opportunity exists to extend the public sewer system. Such extensions shall be approved by the Township.

D. Size – House Connections. House and Building Connections shall be six inches (6”) minimum except where the sewer collector main is six (6) inches in which case the lateral shall be four (4) inches..

E. Materials – Service connection piping material and appurtenances must conform to Township Standard Specifications

F. Appurtenances – Drop house connections may be used, providing that all requirements for grade, depth and clearance have, been met. Drop house connections shall not be allowed at manholes.

H. Grades – House and building connections shall be two percent (2%) minimum to 10% maximum grade. Drop house connections shall only be laid at a 2% slope.

I. Depth – Minimum cover at property line shall be four feet (4’). Where storm drains have not been designed or installed, house connections shall have a minimum cover within the street right-of-way of six and one-half feet (6-1/2’). Maximum depth at property line shall not exceed twelve feet (12’).

J. Alignment – Service connections shall be perpendicular to mains, and have no change in direction between the main or manhole and the clean out at the property line. Services entering a manhole must be placed at an angle 90 degrees or greater than the out-going sewer main alignment. In general, services entering a manhole shall be designed so that the crown of the service main matches the crown of the incoming main.

K. Computation

The tabulated data from Table 00001-1 shall be shown for all house and building connections.

L. Clearance

a. Crossing Water Main: Clearance shall be measured between outside of pipes. Sewer House and Building Connection crossing water mains (existing or future) shall be a minimum of eighteen inches (18”) clearance below water mains. Sewer House and Building Connections crossing above water main shall have a minimum 18 inch clearance and be encased in concrete ten feet (10’) each side of water main. Bell clamps over pipe joints are acceptable in lieu of concrete encasement.

b. Parallel to Water House Service. Sewer House and Building Connections shall ordinarily be not less than ten feet (10’) horizontally from water house service and a minimum of eighteen inches (18”) clear below water house services.

c. Crossing Storm Drains and Other Utilities. Sewer House and Building Connections crossing storm drains and other utilities (existing or future) shall have a minimum clearance of eighteen inches (18”) from these utilities.

M. Abandonment

When a property is developed, all unused service connections shall be abandoned up to property line. Clean outs shall be removed and watertight caps shall be installed.

Table 00001-1 SEWER SERVICE (Example Only)

IV. PRESSURE SEWER (FORCE MAIN)

Lot Number	Station at Sewer (EX MH1-MH2)	Inv. Lateral At Type “B” Sewer Conn.	Inv. And Sta. Drop House Conn.	Length of Service	Slope of Service	Inv. @ R/W Line	Proposed Finish Grade @ R/W Line	Depth of Service @ R/W Line
79	0 + 23	267.98	------	20	2 %	268.38	275.00	7.0
78	0 + 27	268.41	------	11	2 %	268.63	274.13	5.5
77	1 + 01	276.38	------	42	2 %	277.22	288.75	11.5
76	1 + 15	277.35	287.96 Sta. 0 + 15	51	2 %	288.68	292.68	4.0
75	@ MH 2	278.47	------	53	2 %	279.53	284.53	5.0

A. General

1. The following pressure sewer system design guidelines are based on Federal, State and local health requirements and the Township's engineering design criteria.

2. These design guidelines are applicable to all developments including, but not limited to, residential, commercial and industrial developments, subdivisions and/or parks requiring sewer service from the Township.

B. Pressure Sewer Design Criteria

1. Minimum pipe size: 4".

2. Design velocity.

   a. Minimum: 2 feet per second.

3. Type of Pipe and Size Force mains shall be in accordance with the Standard Specifications. Force mains greater than 12 inch in diameter shall be ductile iron pipe (DIP). Force Mains shall be sized to provide initial and future design velocities between 2 and 6 feet per second.

4. Maximum pipe size:

   a. Provide so as to maintain the minimum 2 feet per second velocity and minimize pump head.

5. Hazen and Williams design coefficient:

   a. PVC: C=130

   b. Ductile iron pipe: C=120

C. Air Release Valves

1. Force Mains shall be located to avoid whenever possible high points in the main and the need to vent air. If unavoidable, they should be equipped with automatic sewage air release/vacuum valves located within underground vaults. Manually controlled blowoff valves with flanges or threaded outlets, depending on valve size, shall be placed within vaults at low points in force mains for cleaning and draining force mains.

2. Design force main to minimize the number of air release valves.

3. Provide at 1000-foot intervals where force main is installed at no slope.

D. Plug and Check Valves

1. For force mains greater than 5,000 feet in length, provide a plug valve at the halfway point, or every 4,000 feet.

2. Where a force main is tying into an existing force main:

    a. Provide two (2) plug valves (one upstream and one downstream of the check valve) and check valve on the smaller force main.

    b. Locate all three (3) valves inside an accessible utility vault.

E. Force Mains Entering Manholes

1. No more than two (2) feet, vertically, above the receiving manhole's flowline.

F. Separation of Pressure Sewer and Water Mains

1. Where possible, locate pressure sewer at least ten (10) feet away, horizontally, from water mains.

2. Should ten (10) foot separation not be possible, if approved by the Township, then the pressure sewer may be located up to 5 feet closer provided:

    a. It is laid in a separate trench.

    b. It is laid in the same trench with the water main located at one side on a bench of undisturbed earth.

    c. In either of the above cases, crown elevation of the pressure sewer shall be at least 18" below invert elevation of water line.

3. Where pressure sewers cross under water lines, maintain 18" minimum clearance between outside edges of the two pipes. If crossing over is the only possibility, further requirements apply and must be approved by Engineer.

    a. Use full length of pressure sewer pipe located so that the joints will be equal distance from the water main.

G. Tracer Wire: All force mains, which contain all, or a portion of non-metallic materials shall require the use of a tracer wire in accordance with the Standard Specifications and Details. All sections of non-metallic off site force main shall have test stations for tracer wire at a maximum spacing of every 600 linear feet (min.) by incorporation of a roadway box. In addition, roadway box test stations shall be installed over the force main 5 feet from the pump station and at a location prior to the receiving manhole.

H. Cover

1. Provide suitable cover on all pressure sewers. Minimal cover depth as follows:

    a. 4” diameter through 12” diameter: 3’-6".

    b 14" diameter and larger: 4’-0”.

2. All piping located within the right-of-way of Penn DOT and Township shall have a minimum cover of 48" below the crown of the road when installed within the limits of the paved roadway, 42" cover when installed in the shoulder of right-of-way and a minimum of 24" separation under the design invert of drainage structures. The greater dimension of the above shall dictate minimum depth where applicable.

3. Special conditions other than those listed above may be approved if requested in writing from the Township.

I. Ductile Iron Pipe Locations

1. Use ductile iron pipe where a pressure sewer:

    a. Where sewer lines cross over water mains, the sewer main shall transition to ductile iron pipe. A full length of ductile iron pipe shall be installed in the sewer main centered so that each joint is equidistant from the water main. Joint of ductile iron pipe water main shall also be installed so that each joint is equidistant from the ductile iron pipe section of the sewer main. Mechanical joints will be used for the transition in the sewer line.

    b. Where sewer lines are within the wellhead protection easement of public water supply well or 50 feet of a private well. This is only if relocation further away from the well is impossible.

    c. Crosses beneath storm drainage pipe with less than two (2) feet of clearance. Se Details for bridging and support of the storm drain.

    d. Crosses above storm drainage pipe with less than two (2) feet of clearance. Use proper bridging and support for the water main.

    e. Crosses creeks, rivers and other water bodies.

    f. Installed in casing.

J. Water Hammer: If required by the Township, the Design Engineer shall prepare a complete study of the force main design in conjunction with the pumping station design. A written detailed analysis along with supporting plans and

calculations shall be submitted for review and approval prior to approval of the construction plans. The Design Engineer 's analysis shall include the following:

1. Transient pressures due to water hammer and the effect of these pressures on the entire system.
2. Investigation of the pipeline profile to determine the possibility of water column separation.
3. Reverse rotation characteristics of the pumps
4. Shut off characteristics of the proposed pump control valves
5. A graphic solution of the transient pressures combined with the total system characteristics
6. Substantiation for the use of surge valves.

K Tunnels and Sleeves: Force main under State or Township roads shall be installed in a tunneled or jacked sleeve, as required by Penn DOT or Township. Force Main and sleeves under railroads shall be designed according to specifications of the railroad being crossed. Force main pipe within sleeve shall be Ductile Iron Pipe.

L Termination: Force mains shall enter the gravity sewer system within a manhole and the flow shall be directed into the sewer line by directing the force main towards the sewer opening and by channeling the manhole accordingly. Proper buttresses, anchors and/or restraints shall be installed to support the force main against thrust pressure. Upon request, the Design Engineer shall submit design calculations to the Township to support the design.

M Restrained Joint Pipe: Designs requiring joint restraint shall incorporate the use of restrained joint pipe. Restrained joint field kits by the pipe manufacturer may be allowed for those sections of pipe, which must be cut. The use of "megalugs" will only be allowed for retrofit applications as approved by the Township. Retainer glands (i.e. "megalugs" or similar retaining system) will not be allowed in lieu of restrained joint pipe.

N Odor Control: The Township will evaluate on a case-by-case basis, the need for odor control at any manhole that receives flow from the force main.

V. LOW PRESSURE SEWER SYSTEMS WITH GRINDER PUMPS

A. Low pressure sewer systems are defined as sewer collection systems that contain more than one grinder pump pumping into a common force main header. It is the policy of the Township to promote the use of gravity sewer systems to the extent practical and possible.

B. Pressure sewer systems will not be considered as a method of providing sewer service that could otherwise be furnished by conventional gravity sewer systems. If requesting use of a low pressure system, the Design Engineer shall prove the economic impact of the low pressure system versus a conventional gravity system. A 30-year present worth cost analysis shall be performed in comparing the costs of the two systems. Township and Homeowner routine maintenance costs including pump core and rotor repair and replacement, basin cleaning and homeowner electric costs shall be included in the present worth costs. The Township shall review and approve the 30-year cost analysis. Low pressure sewer systems may be considered if the present worth cost of the low pressure sewer system is less than the conventional sewer system and the site location does not require the extension of conventional gravity sewer beyond the subdivision. Environmental constraints and topographic conditions may also be taken into consideration in the above evaluation.

C. Developer's Engineer shall provide a construction plan showing the location of property, tax parcel number, pump capacity curve together with total dynamic head curve superimposed thereon, connection details, plan and profile view of force main, grinder pump station, house and pertinent topographic features, and location of controller. Drawing shall be presented, on a 24" x 36" sheet, to the Engineer for review and approval at least 90 days prior to start of construction.

D. Design criteria for low pressure grinder pump system shall be based on specific design information found within “Alternative Wastewater Collection Systems Manual” by the United States Environmental Protection Agency. An outline containing general design information from these documents is provided in an attempt to aid the system design engineer in overall understanding, layout, and operation of the low-pressure grinder pump systems for Buckingham Township.

E. Individual Grinder Pump System

1. This section includes materials, performance, installation standards associated with the furnishing of, labor, materials, equipment and appurtenances required to install complete and operational commercial and residential grinder pump systems. These Specifications are the minimum requirements regarding the equipment\application; furnishings, installation, delivery, shop and field-testing of all materials, equipment and appurtenances for the individual types of grinder pump systems as specified herein.

2. The Manufacturer’s recommendations and Construction Drawings may contain additional requirements pertinent to the installation of the individual types of grinder pump systems, including accessory and auxiliary equipment and material types, which are not specified herein.

3. The systems covered by these Specifications are intended to be standard grinder systems of proven ability. The pumps and appurtenances furnished shall be designed and constructed in accordance with the industries standards and methods, and shall operate in accordance with the design and specifications for each individual type system as specified herein. All Pumps shall be manufactured in accordance with the Hydraulic Institute Standards.

F. Types of Systems

1. Simplex Grinder Systems

a. A single pump system operating on 230 volt, single-phase electrical power, in a 3-foot diameter, varying depth fiberglass basin (depth of the basin shall be site specific, minimum of 7-foot deep), and the simplex system is approved for use in all single-family residential units and commercial applications where the wastewater flows are 250 gallons per day or less. The simplex system is however, prohibited, regardless of the flows, for use at the following commercial locations:

- Hair salons
- Barber shops
- Coin laundries
- Car washes and other washing facilities
- Facilities with food preparation
- Industrial flows
- Multiple structures
- Where the physical site conditions prevent a minimum of 1-foot of operating range
- At the discretion of the Township Manager for reasons of public health, safety, or welfare

2. Single-Phase Duplex Grinder System

a. A dual pump system that operates on 230-volt, single-phase electrical power, in a 4-foot diameter, varying depth fiberglass basin (depth of the basin shall be site specific, minimum of 7-foot deep). The single-phase duplex system is approved for use in all commercial applications where the wastewater flows are

1,000 gallons per day or less, and providing the minimum design standards contained herein are maintained.

3. Three-Phase Duplex Grinder Systems

   a. A dual pump system that operates on 208 volt or 230 volt three-phase electrical power, in a 4-foot diameter, varying depth fiberglass basin (depth of the basin shall be site specific, minimum of 7-foot deep). The three-phase duplex system is approved for use in all commercial applications, providing the minimum design standards, contained herein, are maintained.

G. Low Pressure Main System

1. Sizing of the low pressure main system shall be based on the rational design method as stated within "Alternative Wastewater Collection Systems" by USEPA. Specific main sizing shall be determined by the design engineer during final design.

2. Minimum design velocities shall be between 2 to 3 feet per second. This velocity, or higher, will provide self-cleaning action within the main and should occur at least once or twice per day.

3. Locations of low pressure mains will generally follow the horizontal location for force mains previously established. In isolated instances where both low pressure and force mains are proposed along the same roadway then horizontal location for the low pressure main shall be constructed in a more accessible location than the force main. These specific locations shall be determined by the design engineer during final design.

4. Vertical location for low pressure mains shall be set at 48 inches below ground. This depth provides a more consistent profile of the main, less conflict with water services and reduced number of high points in the main where air can accumulate and reduce the efficiency of the main.

H. Valves

1. Valves are an important consideration in low pressure main design. PVC ball valves are recommended for force mains 3 inches in diameter and smaller. Larger than 3 inches, either PVC ball valves or fully ported plug valves may be used.

2. Low pressure main systems shall be valved to facilitate isolation of singular branches within the low pressure main system.

3. Certain maximum spacing requirements should be observed for valve installation, which correspond with spacing requirement for cleanouts.

In low density development, maximum spacing for valving is considered 1,000 feet. For highly congested areas, a maximum spacing of 600 feet should be used.

I. Air Release Valves

1. Air release assemblies shall be provided within the low pressure main at all extreme high points along the main.

2. Two types of valve systems are available: automatic and manual. Automatic air release valves would be the standard ones used for wastewater force main applications. Manual assemblies shall be the standard for low pressure mains, with the exception along aerial crossings where automatic assemblies are recommended.

J. Cleanouts

1. A sufficient number of cleanouts in proper locations is imperative to the successful operation and maintenance of a low pressure main system. A "terminal cleanout," should be installed at all terminal points in the system; for example, in cul-de-sacs. In addition, cleanouts should be located along straight runs at spacings not exceeding 1,000 feet and at the discretion of the design engineer.

2. Cleanouts consist of either a tee or wye fitting on the low pressure main, and are installed with one or more isolation valves. Wye cleanouts without riser pipes can be installed in a meter pit, with appropriate meter/valve box with locking cover, and employed along straight runs and at changes in direction. Cleanouts can be installed with a riser pipe, ball valve and quick-disconnect house coupling installed on a threaded cap or plug arrangement to facilitate manual removal of air from the system.

K. The following procedures to be performed after the operational approval of the low-pressure sewer system installation are provided for informational purposes: Homebuilder coordinates with developer to have underground electric installed between pump basin and exterior of home in accordance with the Standard Details. Homebuilder is responsible for acquiring the control panel, electrical panel, controls, alarm system, and control/power cable from the pump supplier and for the subsequent installation. Homebuilder or his representative coordinates with pump supplier to have pump supplier install pump core, test and troubleshooting. A minimum of a 2-week prior notification to the pump supplier will be necessary to all of the following representatives. Pumps shall be installed a minimum of 2 weeks prior to the final plumbing inspection. Installation, testing and start-up must be witnessed by the Township and/or Engineer, the pump supplier representative and the Homebuilder or his

representative. If all systems function in accordance with the pump manufacturer's requirements, pump supplier approves by means of a start-up report. Copy of start-up report is provided to Township Operations personnel and Engineer. Homeowner/builder is supplied with instructions in case alarm/light sounds or in case a power outage occurs. 2-year manufacturer factory warranty shall begin after successful installation and start-up of the pump core. Prior to the expiration of the Developer's one-year maintenance term on the pressure system, Developer shall be responsible for the maintenance of any properly installed and approved grinder pump. All costs of maintenance during this one-year maintenance period shall be the responsibility of the Developer.

L. The record drawings for the development shall clearly identify all lots that will be served with a grinder pump and shall note that these lots will be served with such a sewage collection system.

VI. RECORD DRAWINGS

A. As built drawings shall be submitted, reviewed, and approved prior to the operational approval. The Developer shall allow for a minimum of two weeks review time for the first submittal.

B. Detailed measurements shall be made of the exact location of all buried piping, including service connections, gate valves, and blow offs. Record drawings of the distribution system shall be in accordance with Specification Section 01725.

C. A "record drawing" reproducible copy of the distribution plan with these dimensions noted shall be filed with Engineer, Buckingham Township, and the entity that will operate the wastewater system, if applicable.

D. Operational approval of systems will not be made until this "record drawing" information is received by Township.

VII. FINAL CERTIFIED INSPECTION

A. Once all other state and local approvals have been obtained a Final Inspection will be performed with the Developer, Contractor, and Engineer and Township Operations personnel. If a portion of the facility is to be installed at a later date (phased with the actual growth of the development), this should be indicated at the time of original submittal.

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SECTION 00002

SEWAGE PUMPING STATIONS DESIGN CRITERIA

I. GENERAL

A. Sewage pumping stations will not be considered as a method of providing sewer service that could otherwise be furnished by conventional gravity sewer systems with depths less than 15 feet deep and with acceptable slopes. If requesting use of a sewage pumping station, the Engineer shall prove the economic impact of the sewage pump station versus a conventional gravity system. A 30-year present worth cost analysis shall be performed in comparing the costs of the two systems. Buckingham Township maintenance costs including electrical costs, routine weekly maintenance costs, labor, replacement of parts, etc. shall be included in the present worth costs. The Township shall review and approve the present worth cost analysis. Sewage pumping stations shall only be considered if the 30-year present worth cost of the pumping station is less than the gravity system and the site does not require conventional gravity sewer to be extended beyond the subdivision. Environmental constraints and topographic conditions may also be taken into consideration in the above evaluation. Existing sewage pump stations shall be upgraded to a capacity to pump both the existing and proposed flows. All appurtenances to existing sewage pump station(s) shall be upgraded to meet the requirements of the upgraded station.

II. PRELIMINARY ENGINEERING

A. Prior to Preliminary Plan approval, the Design Engineer shall prepare a detailed drainage area study for review and approval by the Township. The study shall include a property specific topographic map indicating all properties to be served by the proposed pumping station. The drainage area study shall include computations showing the derivation of the proposed and ultimate design flows. Upon request, Township will supply GIS information to assist the Design Engineer. The service area shall include the drainage areas within the development envelope.

III. SUBMITTAL OF PLANS AND SPECIFICATIONS

A. The Design Engineer shall submit plans and specifications to the Township for review and comment at the 35 and 95 percent phase of design prior to submitting the Part 2 Permit Application for approval. If plans are submitted for review without specifications, an additional review will be required.

IV. STATION TYPE

A. Provide a built in place wet well/dry well pumping station when the design flow rate is greater than .050 mgd. Provide dry-well submersible pumps.

B. Provide a pump station with a wetwell and submersible pumps if the design flow rate is less than 0.05 mgd (if head requirements permit).

V. DESIGN CRITERIA SHOWN ON CONSTRUCTION DRAWINGS

A. The following design criteria shall be shown in the Design Report:

B. Design flows shall be based upon the total ultimate development flow from all contributory areas to the pump station. The design average daily flow shall be based on Equivalent Dwelling Unit (EDU) determination.

C. The design pumping capability of the station shall be based upon the Peak Design Flow which shall be calculated by multiplying the design average flow with the applicable minimum peaking factors as outlined below:

Minimum Peaking Factor	Design Average Daily Flow for Peak Design Flow
Flows to 100,000 GPD	4.0
100,000 GPD to 250,000 GPD	3.5
250,000 GPD to 1,000,000 GPD	3.0
Flows greater than 1,000,000 GPD	2.5

For design average daily flow above 2,000,000 GPD, peaking at factors less than 2.5 may be considered if substantiated by extensive data. Under no circumstances shall peaking factors less than 2.0 are allowed

VI. EQUIPMENT

A. Only equipment compatible with existing components and operations will be considered. It is the scope of this provision to insure uniform operation and to minimize spare part inventory. Interchangeability with existing equipment and emergency connection to this equipment with no adverse effect on operations will be required.

VII. PUMPING UNIT

A. Number of pumping units.

B. Type and size of pumping units including proposed manufacturer(s) and model number(s).

C. Projected flow capacity and head of each pumping unit.

D. Impeller size of pumping unit. (The recommended impeller shall not be the maximum permissible size for the specified pumping unit unless approved by Township)

E. Horsepower, speed, and efficiency for each motor (all motors shall have a high efficiency rating not less than 90%).

F. Display pump curve and system curve and resultant design point. Identify Hazen Williams C factor used to develop system curve and type of pipe proposed. Present pump curves and resultant operating conditions with multiple pumps running.

G. NPSHA and NPSHR.

H. Minimum efficiency at design point.

I. Upgrades necessary for future flow conditions (i.e. pump size, impeller size, motor size, operating conditions). The design shall allow for an increase in impeller size, motor size and other conditions to accommodate future flow conditions.

J. The pumping equipment shall be supplied by single manufacture and have a proven ability as manufactured by a reputable firm having at least ten- (10) year's experience in the production of such equipment. The equipment furnished shall be designed, constructed, and installed in accordance with the best practices and methods, and shall operate satisfactorily.

VIII. WET WELL

A. Wet well shall be minimum six-foot (6') diameter and shall have a minimum four and one-half-foot (4 ½') depth below the lowest invert. Additional depth shall be provided based on station design, cycle time and storage requirements.

B. Pumping levels shall be adjusted to provide a minimum capacity between normal operational water levels sufficient to allow a minimum of five (5) minutes between successive starts of the pumps.

C. The Township requires a minimum one (1) hour storage time at average daily flow.

D. Pump-off water levels shall provide adequate submergence to preclude pump inlet vortexing, overheating or air binding. Operational maximum water levels shall not exceed the invert elevation of the influent pipe.

E. The wet well floor shall have a minimum slope of 1 to 1 to the hopper bottom. The horizontal area of the hopper bottom shall be no greater than necessary for proper installation and function of the pump inlet.

F. No fixed interior ladders shall be permitted in the wet well. Ladder rungs shall be cast into the concrete sidewall away from all other installations.

G. Locate inlet manhole within limits of fenced-in area to allow isolation of wet well during by-pass operations. Manhole shall be lined as required for wet well. Only one wastewater inlet connection shall be permitted to a wet well. All openings in wet well and valve vault shall be manufactured at foundry. No field coring is permitted without Township approval.

H. Wet well shall be constructed of precast units. Cast-in-place shall not be permitted.

IX. VENTILATION

A. Minimum required (show computation).

B. Proposed system with capacity, motor horsepower, motor speed, proposed manufacturer and model.

X. SYSTEM HYDRAULICS/PUMP SELECTION

A. The Design Engineer shall provide a proper wet well design and suction line design in accordance with the Hydraulic Institute Standards to avoid vortexing and cavitation related vibration problems. The NPSHA shall be calculated for the expected design flow and shall exceed the pump manufacturer's requirements by an added margin of safety of not less than 2 feet.

B. The Design Engineer shall avoid applications where pumps must operate in an adverse area of the pump characteristic curve. Examples of these adverse areas include low flows with high heads, near shut off head, and "run out° conditions.

C. The Design Engineer shall specify that the Contractor submit the pump manufacturers certified pump curves, for all pumps, directly from the pump manufacturer during the shop drawing submittal review and approval process.

XI. LOCATION

A. The wastewater pumping station lot shall be dedicated to Buckingham Township in fee simple unless otherwise approved by the Board of Supervisors. The pump station location (including location of emergency generator) shall conform to the Township’s subdivision regulations and zoning code. In residential zoned areas, the wet well, drywell, emergency generator and fence shall meet the minimum setback requirement, measured from the property line.

B. The pump station shall be sited to remain operational and permit access during a 100-year storm event. All facilities shall be protected from the 100-year storm event. The pump station site elevation at the dry well and wet well shall be no less than one foot above the 100-year floodplain elevation.

XII. SITE LAYOUT CONSIDERATIONS

A. When laying out a proposed pumping station site, the following items shall be taken into consideration:

1. Fencing and Paving All sewage pumping stations must have a six-foot (6') high chain link fence surrounding the equipment. The fence should enclose the minimum amount of area necessary to adequately protect the equipment. A fourteen-foot (14') wide double swing gate shall be installed with 180 degrees swing hinge. The area enclosed by the chain link fencing shall be paved. Paving shall extend 1 foot beyond edge of fencing. Paving within fenced areas shall be sloped to provide for positive drainage. The maximum slope within the fenced in paved area shall be no greater than five percent (5%) slope and any off site drainage of significance shall be deviated by means of swales, berms and/or culverts. The paving at manholes and other vault openings shall be crowned to prevent water from ponding or draining into the manhole or vault opening. The paved are shall be large enough to allow for plowing and maneuvering with a full size pickup truck. Stations equipped with Generators or other auxiliary equipment must have fenced area large enough to accommodate service vehicles.

2. Entrance Road: All sewage pumping station entrance roads and tee turn around shall be a minimum width of twelve (12) feet and shall be paved. The turn around shall be a tee turn around with a minimum radius of 20 feet and be located outside of the fenced area. The entrance road profile shall be shown on the plans. The maximum grade of the road and tee turn around shall be five percent (5%). Entrance roads shall satisfy all horizontal and vertical geometry requirements for vehicles in size up to large unit trucks (such as fuel delivery trucks). Entrance road shall accommodate the backing in of a 6,000-gallon tanker truck. Side ditches will be required on either or both sides of the entrance road should the drainage require them. At no time shall the ditches discharge across the paved area. Consideration shall be given to whether a guardrail shall be provided for the entrance drive where the slope from the edge of road is steeper than 4:1 and the vertical distance to a level area is eight (8) feet or greater.

The access road shall be located outside of the 100-year floodplain. The entrance road shall be secured with a 3/8" stainless steel cable that is attached to two four inch diameter concrete filled steel bollards. The cable and bollards shall be located approximately 20 feet from the edge

of the right of way, have "No Trespassing" signs 9 x 12 inches and be provided with a standard Township padlock (supplied by Developer).

3. Landscaping: Landscaping in the form of plantings shall be included as part of the pumping station plan as required by the Township. The purpose of the plantings is to provide a year round screen, if desired, around the pumping station in order to block the views of the pumping station and to prevent unauthorized entry around entrance gate.

   The Developer shall submit a landscaping plan for review and approval to the Township under these requirements.

4. Site Lighting: All facilities shall be illuminated with motion-activated twin floodlights. The floodlights shall be heavy duty with a built in photocell that distinguishes daylight from darkness and provided with a manual on/off switch. When motion stops, lights shall remain on for at least 5 minutes. Lamps shall be 150W incandescent. The facility shall be equipped with enough lights to sufficiently illuminate the fenced in area, Control Panel (if applicable) and generator.

5. Water Supply: The pumping station shall be equipped with a Township-approved 2-inch yard hydrant and an ample supply of water for hosing down wet wells and general maintenance. The hydrant shall be located near the wet well. The water supply line shall contain a properly certified backflow prevention system. Where Municipal water is not available, a well/storage system shall be provided supplying 15 gpm for ½ hour and 5 gpm for 2 hours.

6. Pump around: Connection shall be four-inch (4") or six-inch (6") depending on station size. This will be determined by Township. Connection to include gate valve, adapter flange with quick disconnect male fitting with dust cap.

XII. FORCE MAINS

See sewage collection system guidelines Section 00001 for all information.

XIII. FLOW METERS

A. Magnetic type flow meters with chart recorders shall be installed in all stations. Meter innards must be compatible with grit and other abrasives in the flow. The location of the flowmeter within the station piping shall be in strict adherence to the flowmeter manufacturer's recommendations. All exposed piping shall be coated. Running time metering devices shall be installed on all sewage pumping stations regardless of design flow rate. Stainless steel hardware shall be used in meter vaults. Meter vault shall be drained to the wetwell by means of a manually operated valve wit extension to just below the

vault hatch door. A bypass with isolation valves shall be provided around all flowmeters at built in place pumping stations. Flow meter vaults shall include a GFI receptacle.

XIV. WET WELL PROTECTION

A. Township will, in most cases, require the installation of a comminutor which shall be a Muffin Monster as manufactured by JWC Environmental or approved equal. A manually cleaned Stainless Steel influent trash rack or basket shall be installed at all sewage pumping stations only if approved by the Township. The trash rack shall be attached to Stainless Steel guide rails with three sixteenth inch (3/16") Stainless Steel wire rope that connects to a winch assembly that lowers and raises the basket out of the wet well. A separate access hatch shall be centered over the trash rack assembly for ease of cleaning. Trash racks with circular openings shall have two and one half inch (2 '/2") diameter holes spaced at three and one half inch (3 '/2") on centers. Bar racks shall have two inch (2") clear spacing using one half (1/2") Stainless Steel bars.

XV. STATION CONTROLS:

A. When designing a pumping station control system, the following items shall be taken into consideration:

1. Control Sensing Pump controls shall be initiated with multi-trode sensor located in the pump station wet well. Dual control systems are required as described in Section 02731.

2. Electrical Equipment Cabinet All exterior above ground electrical equipment shall be housed in at least a NEMA 4X (Stainless Steel) enclosure and be U.L. listed. All electrical equipment within the control building shall at least have a NEMA 1 rating.

4. Variable Frequency Drives VFD's are preferred and may be required as determined by the Township on a case-by-case basis.

5. Running time meters shall be provided for each pump to indicate total hours of operation of each pump. A third running meter shall be provided to indicate total hours of operation of both pumps running simultaneously.

XIV. CONTROL BUILDING

A. Electrical/Control Building Pump stations shall have control panels and electrical equipment placed in a well lit ventilated building that has an over hanging pitched roof with asphalt shingles and skylights if requested by Township. The building shall have a minimum area of 120 square feet and be constructed of masonry that has a decorative face or stucco with a masonry

backup. At a minimum, the floor shall be 6" thick reinforced concrete slab. All fascia and soffits shall be covered with maintenance free aluminum trim. The ceiling interior shall receive 8 inches of batt insulation and 5/8" drywall. The entry shall have a minimum (3'-0" x 7'-0") door with a dead bolt lock that is keyed to the Buckingham Township standard. Control Buildings for built-in-place pump stations shall be sufficiently larger in plan to house a bathroom in addition to the station controls. The bathroom shall be a separate enclosed room. It shall be equipped with a sink, toilet, heated water and the sites backflow preventer. All piping containing water shall be located within the confines of this room. Depending on the location and service, the station design may include space for vehicles, equipment, files, and laboratory or office space. Communications connections shall include provision for SCADA monitoring and control from remote locations.

XIIV. Emergency Power Generators

A. All pumping stations shall be equipped with a complete and operable emergency/standby electric generating system. The system shall be capable of automatic and manual start up and cut in operation. The unit shall be adequate to provide power for pumping, lighting, ventilation systems and such other systems affecting reliability, capability and safety. Installation shall be in accordance with applicable National Electric Code. System performance shall be in accordance with applicable NFPA Standards.

1. The emergency power generator shall be a single diesel engine driven electric generator complete with control devices, batteries, battery charger, main line circuit breaker, exhaust silencer, vibration isolators, weather resistant housing and a fuel system. The engine generator set shall be an assembled and tested product of an established manufacturer who has been in continuous production of units of the required size and type for a period of not less than five years.
2. The generator set manufacturer shall have a maintenance and service organization local to the Bucks County area, where skilled, factory trained personnel are available on a 24 hour basis.

3. After installation, the manufacturer shall provide the services of a capable service engineer to conduct a final test and instruct the Township operating personnel. The Township shall also be provided with factory test data indicating that the unit has the specified capacity and is capable of delivering full load continuously. All fuel, lubricating oil antifreeze solution, electrical instruments and equipment required for the Contractor shall furnish the test. The Contractor shall fill the fuel tank after testing.

4. The diesel engine shall be a water-cooled, multi cylinder of the compression ignition, solid injection type. The maximum speed of

engine in the service anticipated shall not exceed 1800 rpm. The lubricating system shall be of the forced feed type.

5. The diesel engine shall operate satisfactorily on a commercial grade of #2 diesel fuel oil.

6. Fuel Storage Tanks Fuel storage tanks shall be of the size and type shown on the table below according to the size of the generator. All belly type tanks shall be double walled.

Generator Size	Minimum Tank Size	Tank Type
Up to 45 KW	175 gals	belly tank, above grade
45 to 100	260 gals	belly tank, above grade
over 100	550 gals	steel, above grade with belly day tank

If the generator design does not allow a belly tank to be installed, the location of the tank shall be as directed by the Township. All generator fuel tanks shall be installed above ground. Double containment shall be provided for the fuel tank in accordance with Local, State and Federal Regulations.

7. The diesel engine shall be complete with all fluids, filters and the industry standard engine governor; engine mounted water heater and safety shut offs.

8. Exhaust Silencers: All generator sets shall have a critical type of exhaust silencer, which shall be constructed of stainless steel. All piping from the manifold, including the muffler, shall be stainless steel and properly insulated for the site conditions.

9. Sound Attenuation: The maximum allowable noise level at any point along the property line shall comply with the Noise Pollution Standards in accordance with the Pennsylvania Regulations. Sound attenuation enclosures may be required as determined by the Township on a case-by-case basis.

XIIIV. SHOP DRAWING SUBMITTALS:

A. The Township Water and Sewer Engineer shall be responsible for shop drawing review and approval. Shop drawing submittals shall include but not be limited to all mechanical and electrical equipment; certified pump curves by the pump manufacturer; pre cast and cast in place concrete; rebar; building structure; and paint. The Township for reference shall retain four sets of approved shop drawings. Township review shall be completed as quickly as reasonably possible but within no more than thirty (30) working days of receipt of shop drawings.

XX. SAFETY

A. All confined spaces (including but not limited to underground vaults, wet wells, dry wells) shall have a permanently mounted bracket located aside the point of entry. The bracket shall be compatible with the portable davit hoist system owned by the Township.

XXI. ODOR CONTROL

A. All sewage pumping stations shall incorporate odor control facilities. All wet wells shall be equipped with odor control system consisting of a Canister filled with sodium hydroxide impregnated activated carbon (as manufactured by the Carbtrol Corporation) together with all air movers, piping, electrical supply, stack and noise abatement.

XXII. SOIL BORINGS

A. The design engineer shall perform a geotechnical evaluation of the proposed pumping station site. As a part of this evaluation, a minimum of four (4) soil borings shall be performed (two within footprint of pump station dry well and two within footprint of wet well). The borings shall extend to a depth three (3) feet below the bottom of the proposed pump station dry well and wet well foundation. Information shall be gathered to determine depth to ground water and the depth to rock (if encountered). Upon completion of the soil borings, the design engineer shall submit the information to the Township for review. The submittal shall include at a minimum soil boring logs, groundwater depths, rock depths, and any other conditions, which could impact the structural design of the pump station.

XXIII. PAINTING

A. When possible, all materials shall arrive at the site with a factory applied finish coat. Ferrous surfaces to be painted include but are not limited to all piping, valves, and mechanical equipment without a factory finish coat.

XXIV. OPERATION AND MAINTENANCE MANUALS

A. Prior to start up, the Contractor shall submit 1 set of O&M manuals for review and comment. Prior to operational approval, two final sets of O&M Manuals shall be submitted for approval. The final submission shall incorporate all review comments.

XXV. FIELD TESTS

A. Prior to operational approval, all pumps shall be tested using the standard draw down method by the Contractor, and witnessed by the Engineer and the Township Operations personnel. If all systems function in accordance with the

pump manufacturer's requirements, pump supplier approves by means of a start-up report. Copy of start-up report is provided to Township Operations and Engineer. Contractor and Township are supplied with instructions in case alarm/light sounds or in case a power outage occurs. A 2-year manufacturer factory warranty shall begin after successful installation and start-up of the pump station. After dedication, all costs of maintenance during the 18 month maintenance period shall be the responsibility of the Developer.

Operational approval shall be dependent upon a successful testing and startup.

XXVI. RECORD DRAWINGS

A. As built drawings shall be submitted, reviewed, and approved prior to the operational approval. The Developer shall allow for a minimum of two weeks review time for the first submittal.

B. Detailed measurements shall be made of the exact location of all buried piping, including service connections, gate valves, and blow offs. Record drawings of the entire system associated with the pump station, including forcemain, shall be in accordance with Specification Section 01725.

C. A "record drawing" reproducible copy of the distribution plan with these dimensions noted shall be filed with Engineer, Buckingham Township, and the entity that will operate the water system (if applicable).

D. Operational approval of systems will not be made until this "record drawing" information is received by Buckingham Township.

XXVII. FINAL CERTIFIED INSPECTION

A. Once all other state and local approvals have been obtained a Final Inspection will be performed with the Developer, Contractor, Engineer and Buckingham Township Operations personnel. If a portion of the facility is to be installed at a later date (phased with the actual growth of the development), this should be indicated at the time of original submittal.

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SECTION 00003

SMALL PUBLIC SEWAGE SYSTEMS

DESIGN GUIDELINES

I. SCOPE

A. It is the intent of this "design guidelines" section to provide sufficient detailed information to enable the Engineer for the Owner/Developer to correctly and efficiently design the overall system for a particular development. If there is a question or a concern regarding the design of any portion of the system that is not adequately answered within this chapter, the owner/developer or his representative shall call the Township to get all issues resolved prior to design. Any deviation from these STANDARDS AND SPECIFICATIONS must be approved in writing by the Township.

B. All proposals to establish or expand a public sewage system shall be submitted to the Township for review and approval before construction. The extent of the submission shall be based on the type and size of the system.

C. All systems shall be designed in accordance with the guidelines outlined below and with the current issue of the PA DEP Domestic Wastewater Manual.

D. It should be noted that the preferred Treatment/Disposal methodology for the Township is Lagoon / Land Application. The Board of Supervisors prior to the start of design must approve any other treatment process.

II. SUBMITTAL OF PLANS AND SPECIFICATIONS

The Design Engineer shall submit plans and specifications to the Township for review and comment at the 35 and 95 percent phase of design prior to submitting the Part 2 Permit Application for approval. If plans are submitted for review without specifications, an additional review will be required.

III. PLANS

A. It is the intent of the submission and approval process that the design documents provide adequate information to analyze the expected system performance and to serve as a detailed permanent record for future owners, maintenance personnel, and the Township staff. All plans to be submitted must be prints of original drawings.

B. All pages must have the project name, project location, date, and date of last revision shown on each sheet. Plans shall be prepared by a registered professional engineer.

C. The site plan must be carefully drawn. Plans and other documents must be neat, fully detailed and drawn to scale. All lettering shall be neatly printed. When preparing the site plan, the following items must be shown:

1. Location plan:

   Location Plan - A plan shall be submitted showing the wastewater treatment plant in relation to the remainder of the system. A USGS Topographic Map (7.5 minute series, where available) shall be included to indicate its location with relation to streams and the point of discharge of treated effluent.

2. Plan title block:

   Name of project :
   Name, address and phone number of owner
   Name of designer and phone number
   Scale
   Design Date

3. Project plan:

   a. Show property boundaries, name of adjacent owners, and ultimate scope of project.

   b. Describe the type of housing and type of occupancy (seasonal/year round).

   c. Show and label all roads, existing and proposed wastewater disposal, green areas, lot numbers and lines, north arrow.

   d. Show the complete collection system including piping size and location, pipe material, manholes, pump stations. Include trench section showing depth of cover, bedding material.

   e. Show contours at not less than two foot intervals.

   f. Plan must be drawn to scale. A scale of approximately 1" = 50' or 1" = 100' is preferred.

   g. Indicate that all construction of treatment system facilities shall be in accordance with Township specifications, PADEP regulations, and these administrative rules.

4. Treatment Plant Plan

   a. General Layout - Layouts of the proposed wastewater treatment plant shall be submitted showing:

1) Topography of the site.

2) Size and location of plant structures-existing, proposed and abandoned.

3) Schematic flow diagram showing the flow through various plant units.

4) Piping, including any arrangements for bypassing individual units. Materials handled and direction of flow through pipes shall be shown.

5) Hydraulic profiles showing the flow of wastewater, supernatant liquor, and sludge.

6) Test borings and groundwater elevations.

b. Detailed Plans - Detailed plans shall show the following:

1) Location, dimensions and elevations of all existing and proposed plant facilities.

2) Elevations of high and low water level of the body of water to which the plant effluent is to be discharged.

3) Type, size, pertinent features and manufacturer's rated capacity of all pumps, blowers, motors, and other mechanical devices, unless included in the specifications.

4) Erosion and sedimentation control measures.

5) Structural Drawings showing rebar placement, thickness of tanks

6) Electrical Drawings

7) Architectural Drawings

5. Control building:

a. Provide at least one detailed scale plan and one section of the proposed control building.

b. Show building dimensions, finished site grading, and vandal proof access door and lock.

c. Label all construction materials for floor, walls, roof, and stairs.

d. Show all piping (size and material), valves (check, gate, pressure reducing), meters, blowers, air compressor, storage tanks, pumps; heat, light, ventilation, gravity floor drain.

e. All chemical storage and feed systems shall be in a separate room with proper corrosion resistant piping and equipment.

f. All blowers shall be in a separate room with sound protection to minimize sound pollution for workers protection.

6. System piping shall be shown on plan and profile sheets at a scale not exceeding 1" = 50'.

III. DESIGN REPORT

A. The purpose of the report is to record, for convenient and permanent reference, the controlling assumptions made and factors used in the functional design of the wastewater facilities as a whole and of each of the component units. The report should include appropriate Pennsylvania Department of Environmental Protection Modules including calculations and justifications for the overall design of treatment facilities including sewers, pump stations and treatment plant.

B. Design Calculations on structural, mechanical and electrical design elements shall be included.

C. Land Application Disposal

1. Exact boundaries of the land application area with setback distances on a one (1) foot topographical survey map.

2. Land uses within one (1) mile of the property.

3. Inventory of potable and non-potable water supply wells and monitoring wells within one-half (0.5) mile radius of the land application site.

4. If expansion of the site is anticipated, the proposed future expansion-site location.

5. Inventory of surface waters within one (1) mile of the land application site with their classifications, their approximate distances, and their uses identified.

6. A soil report on the proposed land application area to include the following information:

a. A U.S.D.A. Soil Conservation Service soil map.

b. Site specific soil borings and test pits to indicate the physical characteristics of the various subsurface soil layers. The borings should be made to a depth of at least ten (10) feet below the average ground water table or to depth of at least twenty (20) feet below the lowest proposed grade of the land application area if groundwater is not encountered. Representative soil profiles shall be submitted and shall indicate physical and chemical characteristics of the subsurface soils pertinent to the design of the effluent disposal system such as the texture, the vertical and horizontal permeability values, the available water capacity, ph, organic content, etc. The locations of the soil borings and the locations and depths of the pertinent tests should be shown on the submitted plans.

7. Testing Requirements for Land-Based Wastewater Disposal

a. Introduction

The design of any land-based disposal system starts with an evaluation of the subsurface at the site of concern. The evaluation is not simple and consideration must be given to both the range of potential design concepts and lack of hydrogeologic homogeneity throughout most of Buckingham Township. It is important that the applicant have a competent geohydrological consultant well versed in defining and measuring the various hydraulic properties necessary for appropriate design.

b. Soil, Rock and Ground Water

The suitability of a “soil-based” wastewater disposal system is determined by the ability of the subsurface materials (soil, rock and ground water) to accept, treat, and dispose of the effluent from the wastewater system. Thus, any proposed testing plan should consider the type and thickness of the overburden that will be required to accept the wastewater as well as the ability of the receiving stratum (whether rock or soil) to transmit the wastewater to its eventual discharge at the ground water table. An applicant should consider and evaluate the surficial soils, overburden materials and bedrock for any variations in quality, anisotropy and type with depth/piezometric head, as well as ground water depth and the hydraulic conductivity of all the receiving materials.

The location, depth and construction details of the monitoring wells should be specified in consideration of the available knowledge of the subsurface conditions at the site in question. In addition, the location, depth and construction of any local (existing or proposed) water supply wells (as well as any existing

wellhead protection areas) should be taken into account during the development of a testing plan.

c. Available Data

Information on the nature of the surficial soils and their physical properties is available from the United States Department of Agriculture, Natural Resource Conservation Service (NRCS) in published documents and unpublished, ongoing work. Subsurface information is available from the United States Geological Survey (USGS), the Pennsylvania Geological Survey (PAGS), local drilling companies, and well installers.

d. Testing and Evaluation Methodology

Conceptually, the infiltration rate for the selected disposal layer will govern the entrance flow into the subsurface. After initial loading, it is generally assumed that effluent flow is nearly vertical with the outer reaches of the plume moving away from this near-vertical flow assumption. The initial downward flow can be through saturated or unsaturated materials depending upon input quantities and material properties. For ease of analysis, the flow is generally assumed to be under saturated conditions. In actuality, however, treatment occurs only in unsaturated flow (aerobic) conditions. Thus, water table depths and permeability relationships need to be defined to appropriately assess the thickness of the unsaturated zone.

When the downward moving fluid meets the water table, it will flow laterally along the water table. As a result, a ground water "mound" will be created below the application zone that will continue to increase in height until the input rate is balanced by the mound-created hydraulic head causing lateral flow. The relatively simple Well & Pit model of Sunada, 1985[1] is often used to calculate mound height. It is believed to yield relatively reasonable answers as long as the model assumptions are appropriate for the existing subsurface conditions at the site.

More sophisticated mathematical models (e.g., MODFLOW) can be used, but the precision of the subsurface input data should be consistent with the demands of the model. Without appropriate input, no mathematical model can be expected to yield realistic results.

[1] Sunada, D.K. , 1985. *Flow from Wells and Recharge Pits*, Colorado State Univ.

There are a number of currently accepted procedures available to measure infiltration[2]. Often, the double-ring infiltrometer test, with the associated dimensions, testing protocols, and reporting procedures of ASTM D 3385[3] are used (Appendix A) because of its relative simplicity and well-documented procedures. The USEPA Design Manual (1981) indicates that the test results of a relatively small infiltrometer such as specified in ASTM D 3385 will likely yield infiltration rates that are too large. Hence, a reasonable factor of safety (on the order of 2?) should be used for analyses. If the test is performed in a suitable manner, the calculated infiltration rate can be assumed approximately equal to the saturated vertical hydraulic conductivity of the tested stratum.

Once the infiltration rate is quantified, it becomes necessary to estimate the hydraulic conductivity/transmissivity and storage coefficient of the underlying strata to be used in the selected mounding analysis. The most common tests would be slug and aquifer tests (e.g., Freeze and Cherry, 1979[4]). Care must be taken in designing the test and analyzing the results as to whether confined, leaky or unconfined conditions exist, or whether saturated or unsaturated hydraulic conductivities are being measured.

Conceptually, the geohydrological testing and evaluation procedures must consider the model shown on Figure III-1. The near-surface materials can be soil or fractured rock. Infiltration testing can be used to evaluate the hydraulic characteristics of the surficial materials. A suitable means of estimating the hydraulic conductivity (or conductivities) of the unsaturated zone must be developed to make sure that no low permeability zone acts as a barrier between the spray field and the water table. Slug tests or the conservative extrapolations of appropriately measured properties from geohydrologically similar on-site locations are viable means of estimation. The flow lines shown will vary with the inclination of the material bedding/fracturing, rock surface, non-uniformity, relative horizontal and vertical hydraulic conductivity (*K*) values, slope of the regional ground water table in the site vicinity, and the proximity of the application area to any down-gradient, receiving water features (e.g., lake, stream, reservoir, etc.). Thus, any testing and evaluation program must inherently consider the variations in

[2] USEPA, 1981. *Process Design Manual for Land Treatment of Municipal Wastewater*, EPA 625/1-81-013.
[3] ASTM D 3385, use current. *Standard Test Method for Infiltration Rate of Soils in Field Using Double-Ring Infiltrometer*.
[4] Freeze, R.A., and J.A. Cherry, 1979. *Groundwater*, Prentice-Hall, Englewood Cliffs, NJ.

the actual subsurface conditions from the ones that are assumed in the simplistic concepts presented herein.

The properties of the aquifer need to be defined such that:

The depth to and thickness of the aquifer below the disposal system should be known as well as any potential differences in the aquifer character in the vicinity to be sampled by the aquifer and/or slug tests.

All potential sources of ground water recharge and discharge should be mapped and considered when locating pumping, monitoring and observation wells.

Estimates of all pertinent hydraulic properties for the receiving aquifer below the disposal system are to be made by any means feasible and appropriate. Accurate estimates of transmissivity (*T*) and storativity (*S*) should be calculated from test matter. In addition, if leaky confining beds are suggested, leakance coefficients should be estimated.

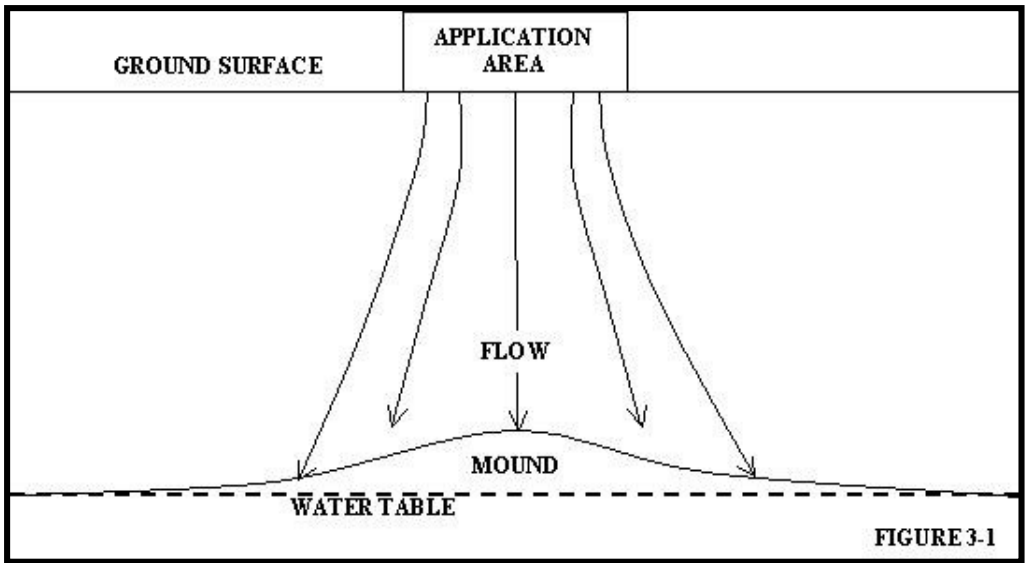

FIGURE 3-1

Of the procedures available for determining *T* and *S* values, the most appropriate is the use of aquifer tests performed in wells installed in materials consistent with those beneath the application areas. Theoretical descriptions of the aquifer type, ground water flow equations, test procedures, and analyses are found in many text books (e.g., Freeze and Cherry, 1979[4]) and

handbooks (e.g., Boonstra, 1999[5]). *S* can only be developed from aquifer test observation well data, not pumping well data.

All of these analyses essentially consist of matching mathematical solutions for various groundwater conditions (i.e., water table, leaky or confined) well penetration (fully- or partially-penetrating the aquifer), and various aquifer conditions (e.g., homogeneous soils, anisotropic flow through bedrock, fractured rock, double-porosity models, etc.). Computer generated curve-matching techniques are readily available for the various different models and should be used to develop aquifer parameters for the appropriate geohydrologic conditions.

Slug tests can be used to define the same parameters as an aquifer test, although the tests are much more location-specific and are quite susceptible to poor well development. However, they are simple and relatively inexpensive to perform. Often, they can be performed in conjunction with aquifer tests to better examine the variability of the geohydrological properties of the subsurface across the area of interest.

Models are available to estimate design parameters from slug tests in confined and unconfined conditions for a range of permeability conditions, for partially- or fully-penetrating wells, and for soil and rock models. Butler, 1998[6] provides a description of the design and analysis of a variety of slug tests.

e. Depth to Water Table

Certainly, one of the most important parameters in the overall analysis of site suitability for surface disposal is a reliable estimate of the depth to the true water table and the potential influence of a confining layer (i.e., seasonal or perched water table). The difference in effect, design and possible remedial effort between a perched water table, a seasonally high water table, or an artesian pressure condition should be assessed and addressed in design. Water level readings should be made across the proposed site during periods of wet weather (generally from November to May). Periodic readings are necessary. Evidence of redox features within any encountered soil horizons should be recorded and the potential for seasonally high water levels evaluated.

[5] Boonstra, J., 1999. *Well Hydraulics and Aquifer Tests*, in Handbook of Groundwater Engineering, CRC Press.

[6] Butler, J.J., Jr., 1998. *The Design, Performance, and Analysis of Slug Tests*, Lewis Publ.

8. A geohydrologic survey to include the following information:

    a. A proposed ground water monitoring plan, if applicable.

    b. The direction and rate of existing ground water movement and the points of discharge; and the anticipated direction and rate of the ground water movement, and points of discharge after land application.

    c. Flood prone areas within one-half (0.5) mile of the site. The frequencies and magnitude of the flooding shall also be indicated.

    d. For rapid-rate and absorption field projects, a ground water mounding analysis based on development specific information shall be included.

9. Spray Field

    a. Monthly application rates shall be presented in the Design Engineer's Report. The hydraulic loading capacity shall be determined by a detailed Hydrological Investigation and Groundwater Monitoring Program shall be provided.

    b. Water Balance

    A general water balance calculation shall be performed to determine the hydraulic loading rate based on soil permeability. Local weather data supplied by NOAA, evapotranspiration data for Seabrook, New Jersey, and site-specific soil permeability test results shall be used in the performance of these calculations. The calculations and a month-by-month determination of the loading rates shall be provided.

    c. Nitrogen Balance

    Evaluation of the nitrogen as a site limiting constraint shall be based on the requirement that the nitrate concentration in the percolate from the effluent irrigation not exceed the permitted limit. A nitrogen balance shall be performed to determine if the design wastewater-loading rate will produce a percolate, which meets this standard. The calculations and a month-by-month determination of the loading rates shall be provided. The crop the site will be planted with shall be determined after consulting with the Township.

d. Spray Zones Information

The spray area shall be divided into the minimum number of spray zones possible. Each zone shall be planned for irrigation one day per week on a rotating basis. Automatic valves located in the control building shall be used to control flow to each zone. Daily initiation and cessation of the irrigation will be managed by the Operator using a programmable controller. The maximum duration of pump time shall be able to be adjusted on a monthly basis to limit the application to the monthly design loading rates.

Full and partial impact solid set sprinklers shall be used for irrigation. The sprinkler nozzles shall be installed on 3 foot 6 inch high-galvanized steel risers. The irrigation pipes shall be 200 psi PVC and shall be buried no less than 3 feet below the surface to prevent freezing. Automatic drain valves shall be installed to drain the lines after each use.

Irrigation shall not exceed .18”/hr. calculated over the nozzle’s full wetted area. The irrigation pumps shall have the flexibility to operate at varying speeds, to shut off and on as programmed to assure complete management capability of the application rates.

The design precipitation rate shall be reduced depending on the slope of the spray fields as follows:

Slope	Precipitation Rate Reduction
0-5% grade	0%
6-8% grade	20%
9-12% grade	40%
13-20% grade	60%
20-25% grade	75%

Slopes greater than 25% will not be permitted.

All fields shall be valved so they will drain automatically to prevent freezing.

e. Noise

All equipment shall be selected and installed with consideration of noise leaving the property and the impact on adjoining properties. The requirement of the Buckingham Township Zoning Ordinance concerning noise in residential areas shall be followed.

D. RATE STUDY

If Required by Township, Design Engineer shall submit a rate study showing all probable costs of operating the system including the necessary sinking fund to provide for long term replacements as the equipment's effective lifespan is over.

IV. SOIL BORINGS

A. The design engineer shall perform a geotechnical evaluation of the proposed site. As a part of this evaluation, a minimum of two (2) soil borings shall be performed for each treatment unit located in the ground. The borings shall extend to a depth three (3) feet below the bottom of the treatment units foundation. Information shall be gathered to determine depth to ground water and the depth to rock (if encountered). Upon completion of the soil borings, the design engineer shall submit the information to the Township for review. The submittal shall include at a minimum soil boring logs, groundwater depths, rock depths, and any other conditions, which could impact the structural design of the treatment units.

V. SPECIFICATIONS

A. The specifications accompanying construction drawings shall include, but not be limited to, all construction information not shown. on the drawings necessary to inform the builder of the design requirements as to the quality of materials, workmanship, and fabrication of the project, and the type, size, strength, operating characteristics, and rating of equipment; the requirements for all mechanical and electrical equipment, including valves, piping, and jointing of pipe; electrical apparatus, wiring, and meters; construction materials; miscellaneous appurtenances; instructions for testing materials and equipment as necessary to meet design standards; and operating tests for the completed works and component units.

B. Specifications need not cover items of construction already set forth in current Township Standard Specifications.

VI. DESIGN REVIEW SUBMITTAL

Complete, detailed, duplicate submittal is required for all community systems

A. Transmittal or identifying letter including owner's name, address and telephone number.

B. Site plan of the entire project:

1. Drawing showing treatment units

2. Drawing showing the control building plan and section

3. Plan and profile drawing of piping system

C. Performance curves of pumps

D. Miscellaneous

1. Easements (if required)

2. Engineering report

VII. WASTEWASTER FLOWS AND LOADING

A. The following are the recommended wastewater flows and peaking factors for different types of housing units that are to be served by Township owned facilities or facilities that will be dedicated to the Township. For any facilities not listed, it is recommended that flow information from similar facilities be submitted for review by the Township.

1. Residential Dwelling Flows (land based):

1. The residential flows are based on a single-family home of 4 bedrooms or smaller and is 225 gpd/edu on systems with over 100 homes.

2. Residential flows to systems between 50 and 100 units shall be 262.5 gpd/edu.

3. Residential flows to systems less than 50 units shall be 350 gpd/edu.

Systems that have only public sewers and private wells shall have a water meter install on the wells to monitor the domestic water usages.

2. Commercial: See Chapter 73 for flow requirements. Divide projected flow by 225 gpd to determine the number of EDU's

3. Modification of these flows may be allowed where specific metered data is available from similar projects.

B. Organic Design

1. Since the influent to a small treatment plant will be domestic wastewater the Design Engineer should only consider domestic loading. Domestic loading consists of loadings from residential, commercial, institutional, and recreational establishments and includes all loadings except from industries. The treatment plant shall be designed to meet the NPDES as well as Part II permit requirements and avoid potential overload as defined under Chapter 94 of the Department's rules and regulations.

2. Various WWTP influent testing has shown following average loading rates and it is suggested that they should used for the WWTP design:

BOD5	443 mg/l
Total Kjeldahl Nitrogen	100 mg/l

The plant must be designed to treat the maximum monthly average organic loading. The shock effects of high concentrations and peak diurnal flows for short periods of time on the treatment process, particularly for small treatment plants, must be considered.

VIII. QUALITY OF EFFLUENT

A. The wastewater treatment plant shall be designed to meet and exceed all NPDES Part I or Part II Permit effluent limitations.

IX. LOCATION

A. All wastewater treatment facilities shall be located as far as possible from any existing or proposed dwellings to avoid potential odor problems. A minimum of 600 feet should be maintained. The direction of prevailing winds must be considered when selecting the plant site. If a critical location must be used, special consideration must be given to the design and type of plant provided. Compatibility of treatment process with the present and planned future land use, including noise, potential odors, air quality, and anticipated sludge processing and disposal techniques must be considered.

B. Safety of the public must be considered in selecting the location.

C. The facility shall be visually screened from residences by the use of wooden fencing or landscaping it if is a mechanical treatment plant.

D. Flood Protection - The treatment plant structures, electrical and mechanical equipment shall be protected from physical damage by the 100-year flood. Treatment plant should remain fully operational and accessible during the 25-year flood. This applies to new construction and to existing facilities undergoing major modification.

X. ACCESS

A. All treatment facilities shall be accessible by a tandem axle truck. Sufficient space for parking shall be provided and access drive and parking area shall be paved.

B. Chain Link fencing of all mechanical treatment plants shall be required to protect it and the public. Fencing requirements shall be per Section 02831.

XI. SYSTEM COMPONETS

A. Flow Equalization

1. Flow equalization shall be provided for in all treatment facilities unless specifically declined by Township.

B. Influent Screening

1. In order to protect the plant from reduced efficiency and/or physical damage, all plants shall be equipped with one or more of the screening devices (mechanically cleaned fine screen or comminutor). Provisions for odor control must be investigated and provided whenever a potential problem may develop

a. For flows less than 25,000 gpd a comminutor may be used.

b. For flows over 25,000 gpd a fine screen shall be used.

2. Location

a. Indoors - Screening devices installed in a building where other equipment is located must be in a separate portion of the building that is accessible only through a separate outside entrance. Screens shall not be in buildings that house offices or laboratories.

b. Outdoors - Screening devices installed outside shall be protected from freezing.

c. Access - Screening areas shall be provided with stairway access, adequate lighting and ventilation, and a convenient and adequate means for removing the screenings and maintaining equipment.

3. Bypass Manual Screen

a. The influent channel shall be equipped with an emergency bypass and a manual bar screen. The emergency bypass is designed to take the maximum daily flow rate if the automatic screen fails for any reason.

b. The bypass channel will be isolated from normal flow by an emergency bypass gate / weir. The bottom of this weir will be 2” above maximum water level in the influent channel. In cases of emergency, the influent flow will rise above the bypass gate and flow into the bypass channel.

c. This channel will be equipped with a manual bar screen to remove large materials out of the waste stream

4. Screenings Removal and Disposal - A convenient and adequate means for dewatering and removing screenings shall be provided. Hoisting or lifting equipment may be necessary depending on the depth of pit and amount of screenings or equipment to be lifted.

5. Equipment

a. The fine screen shall be manufactured by Lakeside or approved equal.

b. The comminutor shall be a Muffin Monster as manufactured by JWC Environmental or approved equal.

C. Treatment Lagoon

1. All lagoon systems shall have a minimum of three separate lagoons. Every effort shall be made to fit the lagoons into the surrounding landscape and to have a farm pond like appearance. The lagoons shall be lined with a HDPE liner with a soil cover and stone on the side slopes and under aerators. More detailed requirements are provided in the Township Standards. The operator shall have the ability to place any single lagoon off line through valves and by-pass piping which shall be part of the design. All lagoons shall be provided with aeration per the Township standards and specifications. Upon completion of construction, each lagoon shall be filled with clean water and tested per the standards in Appendix 1.

D. Aeration Equipment

1. Blowers shall be of the rotary lobe, positive displacement type and shall be redundant.

2. They shall include intake filters with silencer, discharge silencer, vibration isolator, and pressure gauge. Manometer showing pressure loss across filter.

3. The blowers shall not exceed 85dBA decibels within the room they are located.

4. The blowers shall be housed in a separate noise insulated portion of the operations building away from the normal work area for the operator. The blower room shall be ventilated or air-conditioned to reduce heat buildup.

5. The blowers shall be manufactured by Dresser Industries, Roots Division or approved equal.

6. The blowers shall be driven by three phase electric motors when possible and controlled by a 24-hour programmable controller and normal operating switches. Blowers shall be equipped with variable frequency controls as approved by Engineer.

7. Diffusers shall be fine-bubble or as otherwise directed by Engineer and be removable without dewatering the tanks. Spare diffusers shall be provided (supply 110% of total needed).

8. All piping for submerged air distribution shall be 316 stainless steel.

E. Effluent Storage Lagoon

1. Effluent storage shall be determined based on the flows, month-by-month application rates and the needs of agricultural activities as well as incorporating capacity for rainfall. A minimum of 107 days shall be provided at average daily flows. A chart shall be provided showing the availability of storage against the water being disposed of, the incoming flow and precipitation entering the lagoon.

F. Pumps

1. Influent lift pump stations shall meet the requirements of the sewage pump station guidelines.

2. All other pumps shall be sized and selected to meet the requirements of the material to be pumped and shall be selected to avoid clogging, be easily accessible, and have provisions for backup operations if critical to the day to day operation of the plant.

3. Effluent pump station shall consist of a pair of submersible or vertical turbine pumps. Detailed pump design calculations shall be provided for each spray field. Automatic butterfly valves inside the control building shall be provided to throttle flow for each field. The given flow rate for the field being sprayed shall be display on the effluent flow meter for the operator's use.

4. Acceptable manufacturers shall include Flygt, Fairbanks Morse, or approved equal.

5. Non-submersible pumps shall be provided with drains for packing boxes, if required.

6. Township reserves right to require variable frequency motor controls or other suitable flow matching equipment.

G. Emergency Power

1. An emergency electrical generator capable of operating all essential plant equipment on a temporary basis shall be provided. Equipment to be operated includes influent pumps, disinfection equipment, blowers, lights, and other pumps required to prevent the discharge of untreated wastewater.

2. The emergency generator shall be capable of all weather starts and housed in a weatherproof enclosure.

H. Filtration Equipment

1. Filters shall be required either as an integral part of any mechanical treatment process or as a safety measure to prevent unacceptable discharges to the stream in the event of plant upsets or equipment failures.

2. The filters shall be of the filter cloth or continuous flow automatic backwash.

3. Acceptable manufacturers include Parkson Corporation (Dyna Sand), and Aqua Aerobics or approved equal.

4. The filters shall be weatherized to allow for year-round operation.

I. Disinfection

1. Sodium hypochloride solution shall be fed from a storage tank to the effluent by chemical feed pumps located in a separate room in the control building. The fecal coliform concentration in the effluent will be maintained at $\leq$ 200 colonies/100 ml. Prior to irrigation, the required 15 minute contact time at maximum flow rate shall be provided by the volume of the effluent force main.

J. Control Building

1. Building # 1 shall be provided to house the controls, blowers and other necessary equipment, including site maintenance vehicles and at least one full sized pickup truck. All chemical storage and feed systems shall be in a separate room with proper corrosion resistant piping and equipment.

2. Building # 2 shall be provided with a separate operator room, lab, shower and bath facilities that may also contain the electrical controls but no major mechanical equipment. The operator's room may be combined with the

lab at Township's discretion and, if such is permitted, must contain at least 20 square feet of chemical resistant counter space, required laboratory equipment and a lab sink and a bench for working on mechanical equipment. It shall provide enough storage space in cabinets for all laboratory equipment and supplies and all tools.

3. The building shall be insulated to current standards and provided with an automatic heating system and entry alarm system as specified by current Township security Policy (minimum system would have contact breakers at each door and window, touchpad entry system at all doors recording date, time, operator identification.

4. Control buildings for treatment facilities with flows above 75,000 gpd may require additional facilities such as more rest rooms and greater laboratory and equipment storage space.

5. The layout of equipment and the design of the building must allow convenient operation and preventative maintenance. The design shall make provisions to minimize the vandalism damage to wells, doors, and roofs. Windows shall be avoided. The walls and ceilings shall be fully insulated. Metal doors reinforced with solid steel plates and vandal proof locks are required. Township must sign off on layout and number of buildings before final design.

K. Flow Meters

1. Influent Flow Meter

   a. A magnetic flow meter shall be installed on the discharge of the influent pump station. The influent meter must be designed for pumping wastewater containing sand and grit and equipped with a remote recorder and SCADA interface.

2. Effluent Flow Meter

   a. If plant effluent flow is by gravity, an open channel flow meter shall be installed in a Parshall Flume prior to the outfall. This flume will measure the discharge flow rate and record this information in the main plant's system control panel equipped with a remote recorder and SCADA interface.
   b. If plant effluent flow is by pressure a magnetic flow meter shall be installed in the discharge pipe. This meter will measure the discharge flow rate and record this information in the main plant's system control panel equipped with a remote recorder and SCADA interface.

L. Sludge Processing

1. All sludge shall be processed to allow for its disposal at a licensed sanitary landfill. The processing equipment must be able to dry the sludge consistently to above 20 percent solids.

2. Sufficient storage space shall be provided to store the sludge in either a liquid or processed state to allow for cost effective processing or transportation of the material. All Sludge storage areas must be both easily accessible to the operators and ventilated through an approved odor elimination system.

3. Those facilities with flows less than 75,000 gallons per day shall be reviewed to determine if the sludge should be transported to another facility for processing. A cash contribution in lieu of constructing sludge processing facilities at the smaller plant may be an acceptable alternative.

M. Miscellaneous Equipment

1. Laboratory supplies shall include all necessary automatic samplers, glassware, oxygen and pH meters, ovens, incubators, test kits and miscellaneous hardware and chemicals to perform all NPDES permit sampling and analyses required of the specific treatment system and plant. See specification 11600.

2. Fire Fighting Equipment

The fire extinguishers shall be of the following type:

a. ABC Dry Chemical: 20 lbs. capacity, enameled steel container with pressure-indicating gauge, for Classes A, B, and C fires.

b. The fire extinguishers shall be as manufactured by W.D. Allen Co., Casco Products Corp., General Fire Extinguisher Corp., or approved equal.

c. An extinguisher shall be located in each room of the control building.

3. Other Safety Equipment (all as approved by Township):

a. Self Contained Breathing Apparatus (Scott)

b. 4-gas sensor (MSA)

c. Confined space entry crane and retrieval system (DBI/Sala)

N. If a treatment process other than Lagoon/Land application is approved, the following shall apply:

1. Aeration, Settling, Sludge Holding, Equalization and other treatment tanks.

    a. All tanks shall be constructed of reinforced concrete under the provisions of Section 03300 or 03400 of the standard specifications.

    b. The tanks shall be protected from floatation and flooding.

    c. They shall be designed with sufficient freeboard to prevent over-topping.

    d. If the tanks are set within 3-0' of ground level, they shall be covered with grates or surrounded with railing (Section 05520 or 05530.). All grates and railing must be easily removable in sections to allow for maintenance.

    e. All tanks shall be accessible by operating personnel for equipment maintenance.

    f. Sumps shall be provided in all tanks that require periodic cleaning or sludge removal. Permanent sump pumps shall be installed in all tanks requiring draining bi-monthly or more often.

    g. All piping located inside the tanks shall either be stainless steel or C-900 PVC at the direction of Township.

2. Ultra-Violet Disinfection

    a. Due to the increasing concerns about using chlorination for disinfection it is proposed to use Ultraviolet Light (UV) disinfection for the plant effluent if discharged to a stream.

    b. In the system, the ultraviolet light shall be generated by means of low-pressure mercury arc lamps (similar in construction to fluorescent lamps), which are set in an open channel. Over 85 percent of the UV output from these lamps is at the germicidal wavelength of 253.7 nm.

    c. Effluent should flow by gravity from the filtration system through the UV unit. The unit shall be equipped with an automatic level control system that keeps the level of the effluent in the channel constant.

    d. A system control panel will monitor UV intensity, individual lamp status, lamp operating hours, UV transmission and UV dose applied. Any alarm conditions will be sent to the plant's central

computer to notify the operator of a problem. All UV systems shall be easy to maintain without excessive disassembly.

d. The system shall be manufactured by Trojan Technologies or approved equal.

XII. SHOP DRAWING SUBMITTALS:

A. The Engineer shall be responsible for shop drawing review and approval. Shop drawing submittals shall include but not be limited to all mechanical and electrical equipment; certified pump curves by the pump manufacturer; pre cast and cast in place concrete; rebar; building structure; and paint. The Township for reference shall retain four sets of approved shop drawings. Township review shall be completed as quickly as reasonably possibly but no longer than within thirty (30) working days of receipt of shop drawings.

XIII. SAFETY

A. All confined spaces (including but not limited to underground vaults, wet wells, dry wells) shall have a permanently mounted bracket located aside the point of entry. The bracket shall be compatible with the Township's portable Confined space entry crane and retrieval system.

XIV. ODOR CONTROL

A. All treatment plants shall incorporate odor control facilities at all locations designated by Design Engineer and approved by Township.

XV. PAINTING

A. When possible, all materials shall arrive at the site with a factory applied finish coat. Ferrous surfaces to be painted include but are not limited to all piping, valves, and mechanical equipment without a factory finish coat.

XVI. OPERATION AND MAINTENANCE MANUALS

A. Prior to start up, the Contractor shall submit 2 sets of O&M manuals for review and comment. Prior to operational approval, four final sets of O&M Manuals shall be submitted for approval. The final submission shall incorporate all review comments.

XVII. FIELD TESTS

A. Prior to operational approval, all pumps shall be tested using the standard draw down method by the Contractor, and witnessed by the Engineer and the

Township Operations personnel. All other equipment must be tested according to a pre-approved plan if all systems function in accordance with the manufacturers' requirements, suppliers approve by means of a start-up report Submitted to Contractor. Copy of all start-up reports are provided to Township Operations staff and Engineer. Contractor and Township are supplied with instructions in case alarm/light sounds or in case a power outage occurs. A 2-year manufacturer factory warranty shall begin after successful installation and start-up of the pump station. After dedication, all costs of maintenance during the 18 month maintenance period shall be the responsibility of the Developer.

Operational approval shall be dependent upon a successful testing and approval.

XVIII. RECORD DRAWINGS

A. As built drawings shall be submitted, reviewed, and approved prior to the operational approval. The Developer shall allow for a minimum of two weeks review time for the first submittal.

B. Detailed measurements shall be made of the exact location of all buried piping, including service connections, gate valves, and blow offs. Record drawings of the distribution system shall be in accordance with Specification Section 01725.

C. A "record drawing" reproducible copy of the distribution plan with these dimensions noted shall be filed with Engineer, Township, and the entity that will operate the wastewater treatment facility.

D. Operational approval of systems will not be made until this "record drawing" information is received by Township.

XIX. FINAL CERTIFIED INSPECTION

A. Once all other state and local approvals have been obtained a Final Inspection will be performed with the Developer, Contractor, and Engineer and Township Operations personnel. If a portion of the facility is to be installed at a later date (phased with the actual growth of the development), this should be indicated at the time of original submittal.

End of Section

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SECTION 00004

DESIGN STANDARDS FOR

SMALL PUBLIC WATER SYSTEMS

I. SCOPE

A. It is the intent of this "design standard" section to provide sufficient detailed information to enable the Engineer for the Owner/Developer to correctly and efficiently design the overall system for a particular development. If there is a question or a concern regarding the design of any portion of the water system that is not adequately answered within this chapter, the owner/developer or his representative shall call the Township to get all issues resolved prior to design. Any deviation from these STANDARDS AND SPECIFICATIONS must be approved in writing by the Township.

B. All proposals to establish or expand a public water supply system shall be submitted to the Township for review and approval before construction. The extent of the submission shall be based on the type and size of the system.

C. All systems shall be designed in accordance with the guidelines outlined below and with the current issue of the PA DEP Public Water Supply Manual.

D. A "small" public water system is a stand along system (not connected to other systems) serving a population of 25 greater persons with or without fire protection capability.

II. PLANNING

Per Township Ordinance 2003-09 (the Well Ordinance) a preliminary site evaluation is required. The intent of this evaluation is to identify the best possible location for the wells, to avoid conflicts with other intended uses of the property and to identify existing and potential source of contamination. This report shall also include the water budget analysis as required by the Well ordinance.

III. DESIGN

A. It is the intent of the submission and approval process that the design documents provide adequate information to analyze the expected system performance and to serve as a detailed permanent record for future owners, maintenance personnel, and the Township staff. All plans to be submitted must be prints of original drawings.

B. All pages must have the project name, project location, and date shown on each sheet. Plans shall be prepared by a registered professional engineer.

C. The site plan must be carefully drawn. Plans and other documents must be neat, fully detailed and drawn to scale. All lettering shall be neatly printed. When preparing the site plan, the following items must be shown:

1. Location key plan:

   Size: Not less than 3" x 3"

   Scale: Equal to latest U.S.G.S. (1" = 2000', if available)

   Identification: Label streets and other principal feature

2. Plan title block:

   Name of project

   Name, address and phone number of owner

   Name of designer and phone number

   Scale

   Design Date

3. Project plan:

   a. Show property boundaries, name of adjacent owners, and ultimate scope of project.

   b. Describe the type of housing and type of occupancy (seasonal/year round).

   c. Show and label all roads, existing and proposed wastewater disposal, green areas, lot numbers and lines, north arrow.

   d. Show the complete distribution system including piping size and location, pipe material, gate valves and blow offs. Include trench section showing depth of cover, bedding material.

   e. Show contours at not less than two foot intervals.

   f. Plan must be drawn to scale. A scale of 1" = 50' or 1" = 100' is preferred.

   g. Indicate that all construction of water distribution system facilities shall be in accordance with Township specifications, PA DEP regulations, and these administrative rules.

4. Well detail

a. Locate proposed water supply source(s) with at least two measured dimensions to fixed and visible points. Draw appropriate protective radius.

b. Show type and depth of well, and size and length of casing.

c. Show static water level and maximum draw down at tested rate.

d. Show elevation at which pump will be installed.

5. Control building:

a. Provide at least one detailed scale plan and one section of the proposed control building.

b. Show building dimensions, finished site grading, and vandal proof access door and lock.

c. Label all construction materials for floor, walls, roof, and stairs.

d. Show all piping (size and material), valves (check, gate, pressure reducing), water meter, sampling tap, air compressor, storage tanks, booster pumps, heat, light, ventilation, gravity floor drain.

e. Show level controls (off/on), low water level alarm.

6. Potential sources of groundwater contamination. The site plan or equivalent separate plan shall show by directional arrow, distance, and tax parcel number the location of potential sources of groundwater contamination by hazardous wastes within the following radii of the proposed well site(s): For subdivisions of 10 lots or less, 1/4 mile; for subdivisions of 11 to 50 lots, 1/2 mile; and for subdivisions of more than 50 lots, 1 mile. Such sources shall include, but not be limited to, active and inactive landfills, active and inactive oil and chemical storage facilities, active and inactive chemical intensive industries, probable low level radioactive waste disposal sites, gas stations or any facility that would have underground storage of hazardous material, oil pipelines, trash transfer stations, and any industry handling solvents. Type of material indicated as a potential source of groundwater contamination shall also be named.

7. Distribution system piping shall be shown on plan and profile sheets at a scale not exceeding 1" = 50'.

IV. SPECIFICATIONS

A. The specifications accompanying construction drawings shall include, but not be limited to, all construction information not shown on the drawings necessary to inform the builder of the design requirements as to the quality of materials, workmanship, and fabrication of the project, and the type, size, strength, operating characteristics, and rating of equipment; the requirements for all mechanical and electrical equipment, including valves, piping, and jointing of pipe; electrical apparatus, wiring, and meters; construction materials; miscellaneous appurtenances; instructions for testing materials and equipment as necessary to meet design standards; and operating tests for the completed works and component units.

B. Specifications need not cover items of construction already set forth in current Township Standard Specifications.

V. DESIGN REVIEW SUBMITTAL

Complete, detailed, duplicate submittal is required for all community systems

A. Transmittal or identifying letter including owner's name, address and telephone number.

B. Site plan of the entire project:

1. Drawing showing a section through the well
2. Drawing showing the control building plan and section
3. Plan and profile drawing of distribution system

C. Pump test log

D. Copy of Water Quality Analysis

E. Performance curves of pumps

F. Miscellaneous

1. Easements (if required)
2. Engineering report (if necessary)

VI. ANNUAL AVERAGE DAILY DEMAND

A. The annual average daily water system demand shall be based on the type of dwelling or use and determined by the following water use table.

B. Modification of these flows may be allowed where specific metered data is available from similar projects.

C. If the specific type of use is not listed above, Developer shall submit to the Township adequate data to justify, in the Township's opinion, Developer selected water use figures.

D. The developer shall specify the type of landscaping planned for the project. Where the nature of the development will or could conceivably in the future require substantial extra water supply capacity for lawn watering, swimming pools, gardens, livestock, and other unusually high water demand situations, additional supply capacity must be provided.

E. Luxury Homes – Higher flows will be required for dwellings where high water use fixtures are proposed.

VII. ACCEPTABLE SOURCES OF WATER SUPPLY

A. If the proposed new system is of the "community type" individual system, and if the number of services exceeds 5, a minimum of two wells shall be required. For the purpose of this paragraph, a "community type" system is one ultimately proposed to service a permanent residential population even if that population initially is weekend or seasonal in nature.

B. If connection to a municipal system is involved, only one well may be required. Additionally, a letter of certification from the supplying system must be submitted.

VIII. WELL LOCATION

A. It is required that the well be located at least 25 feet from surface waters and natural drainage ways, and not subject to a 500 year flood.

B. The well must be kept at least 100 feet from the edge of road rights of way to minimize contamination from de-icing salts.

IX. WELL HEAD PROTECTIVE RADIUS

A. In order to protect the long term quality of each public water supply system, a protective area (radius) shall be established around each source. The criterion for defining the extent of this radius is in accordance with the Pennsylvania Department of Environmental Protection “Well Head Protection Guidelines” and the following.

B. Wastewater disposal. A protective radius shall be established around each source within which no sewage or wastewater disposal system shall be permitted.

C. Other hazardous uses. Acceptable uses are excluded from the protective radius of a community public water supply. The following uses are specifically excluded from within the protective radii of these systems.

1. Permanent buildings

2. Septic tanks

3. Soil fertilization

4. Storage of oil, gasoline, or other hazardous chemicals

5. Other hazardous uses as determined by PADEP and/or HTWSA.

D. Acceptable uses of the protective radius. Where suitable precautions are taken, the following may be included within the protective radius:

1. Tennis courts

2. Surface water such as lakes, rivers, and streams

3. Permanently protected land

4. Other compatible uses as determined by Township.

E. Control of the protective radius. The area within the protective radius should exist entirely on the developer's property. If this is not possible, written legal easements from abutters must be obtained. Such easements must specifically exclude the hazardous uses described above from the area within the protective radius. Where this radius is on the developer's property, the area within the protective radius cannot be subdivided for sale, but must be owned or controlled by the owner of the water system.

X. WATER SUPPLY QUANTITY

A. Adequate supply quantity must be proven by a sustained pumping test performed under the supervision of a qualified hydrogeologist, and in accordance with Delaware River Basin Commission guidelines and Buckingham Township Ordinance #2003-06 as last revised.

B. The minimum source capability for community systems shall not be less than 2-1/2 times the anticipated annual average system demand. A source capacity of 1.6 times the average annual daily demand shall be acceptable for systems that have an alternate non potable water supply for such uses as watering lawns, watering gardens, and filling swimming pools or where deed covenants restrict exterior water use. A source capacity of 2 times the average daily demand shall be required for those non-community systems serving transient users such as motels, restaurants, campgrounds.

C. Where possible, wells should be test pumped in the late summer when groundwater tables are lowest and the source is test pumped at its highest feasible safe yield.

XI. WATER QUALITY

A. A water sample shall be taken from each source and analyzed for quality by a laboratory approved for Safe Drinking Water Act testing. Results from

unapproved laboratories cannot be accepted. Samples shall be taken at the completion of the pump test. Dip samples from wells that have not been pumped for a sustained period are not acceptable.

B. Special containers and sampling techniques are required for those sources that will supply community systems. The PA DEP and Bucks County Department of Health must be notified so they may take whatever samples they require to permit the well.

C. Water quality must meet the standards established in "National Primary and Secondary Drinking Water Regulations". The analysis must have been performed within the previous six months.

XII. SYSTEM CONCEPT

A. For any particular project there is likely more than one approvable water system design concept. These rules are not meant to specify a particular design concept, but to insure water system adequacy and reliability. Factors governing the design criteria of the three most common concepts used for small systems are noted below. In any particular circumstance, a modification or combination of these concepts may be appropriate:

1. Hydropneumatic storage only (i.e. straight pressure). Multiple, high capacity wells (or source pumps) are required. These systems are only acceptable for systems serving 25 or fewer homes.

2. Accumulation and hydropneumatic storage. One or more wells with low or intermediate yields discharge into a relatively high capacity holding tank. Water from this tank is then re-pumped into the hydropneumatic tank for direct feed into the distribution system by high capacity pumps rated at peak flow.

3. Gravity storage. A minimum pressure of 30 PSI (2nd floor of highest unit) during peak flow is required. This requires that the highest service connection be approximately 70 feet lower (measured vertically) than the low water level of the storage tank.

XIII. SIZING OF STORAGE TANKS

A. Atmospheric (including gravity) storage:

For systems with more than one source:

Minimum groundwater source capability with largest producing well out of service	Atmospheric Storage required (percent of average

	day demand)
Peak hourly demand	50 percent
2.5 times the avg. day demand	75 percent
1.5 times the avg. day demand	100 percent
Less than 1.5 times the avg. day demand	Not acceptable

B. Hydropneumatic pressure storage:

1. For conventional hydropneumatic storage equipped with sight tubes:

Type of Use	Required Storage
Apartments, condominiums	100 gallons per unit
Single family housing development	150 gallons per unit
Mobile home park	100 gallons per site
Campgrounds	50 gallons per site
School	20 gallons per person

2. Precharged hydropneumatic tanks will be accepted on an equivalency gross volume basis to conventional hydropneumatic storage. No more than six tanks of the precharged type shall be permitted.

XIV. PEAK FLOW

A. The Township shall be contacted to determine the peak flow factor.

XV. SIZING OF BOOSTER PUMPS

A. Total booster pump capacity shall be at least equal to peak hourly demand.

B. Booster pumps shall be in duplicate.

XVI. MAJOR SYSTEM COMPONENTS

A. Control Building - An all weather building shall be included in the system to house the following equipment:

1. Chlorination, sequestering and pH adjustment (and other required treatment)
2. Major Control Valves
3. Meters

4. Electrical Controls

5. Other necessary mechanical equipment

B. In addition to the general control system, an alarm system shall be provided for systems that service over 5 dwellings. The alarm system shall note failure of pumps and low tank levels. Alarm system shall incorporate an automatic telephone dialer. The telemetry equipment to be supplied shall be compatible with existing Township SCADA Control Systems. A Raco Verbatim auto dialer to be provided and installed per direction of Township.

D. All systems shall be provided with a system water meter after the storage tanks. A flow meter shall be provided for each water source as manufactured by Rockwell or approved equal. It shall be supplied with a seven-digit straight reading type register in 10's of gallons. It shall also be provided with a pulse transmitter and 12-inch circular chart recorder.

E. All stations must have gravity floor drains with all floors pitched towards the drains. Sump pumps are not acceptable. Thus, the floor level must be above the seasonal high water table.

F. All well sources shall be capable of being separately sampled for water quality before entering storage tanks.

G. All storage tanks will have drains. All outside tanks should be totally backfilled to minimize damage to tank coating. Atmospheric storage tanks shall have a down turn "U" vent with screening. Storage tanks must be located above the seasonal high ground water table to prevent possible flotation when empty.

1. Gravity Storage Tanks shall be glassed line tanks as manufactured by Aqua store Inc.

2. All buried steel storage tanks shall be installed in accordance with current industry practice and provided with an adequate passive cathodic protection system, and have protective coating both inside and out. The interior coating shall be certified as being manufactured and applied in accordance with the approved listings of the U.S. Environmental Protection Agency (EPA), American Water Works Association (AWWA) or National Sanitation Foundation (NSF). Damage to the exterior coating during construction shall be repaired under the manufacturer's supervision prior to tank backfill.

H. A pressure gauge shall be provided before and after storage tanks.

I. The layout of equipment and the design of the building should allow convenient operation and preventative maintenance. The design shall make provisions to minimize the vandalism damage to wells, doors, and roofs. Windows shall be avoided. The pump station walls and ceilings shall be fully insulated. At low or below ground pump stations, wooden roofs with asphalt shingles are

particularly vulnerable to vandalism damage. Metal doors reinforced with solid steel plates and vandal proof locks are required.

J. The developer shall make every reasonable effort to design and construct the pump station to be at grade. Where difficulties are encountered, the station may be as much as 5 feet below grade. Where the floor is below grade, the access stairway shall have a slope of not more than 7:9 (7" riser, 9" tread width) and a hand railing on one side.

K. All piping in the pump house should be color coded. Directional arrows should be provided to note the normal flow direction and function of each valve or other device labeled. A pressure gauge shall also be provided.

L. A high capacity flushing outlet is required at the pump station to allow testing of the performance of the pump.

M. To measure drawdown, an air line should be installed along with the pump. (Note: A spare air line is recommended.)

N. Electrical control devices are subject to corrosion and failure; small heaters, in or near the control panel, should be considered to prevent corrosion and subsequent failure of the controls.

O. In general, high moisture conditions exist, both inside the building and out. Poured in place concrete walls and concrete block walls with precast concrete planks, or poured in place roofs are recommended as building material. Architecturally textured form work or brick veneer can be used to improve exterior appearance. Non rotting material should be used everywhere possible.

P. Chlorination Equipment - The chlorination equipment shall be capable of meeting the PA DEP disinfection requirement and shall utilize sodium hypochlorite. Storage shall be provided for two weeks of diluted sodium hypochlorite. The chlorinator shall be manufactured by Liquid Metronics or approved equal. Duplication per Act 109 is required.

Q Miscellaneous Equipment

1. Furniture: desk, chair, filing cabinet, counter space, sample sink.

2. Spill containment or floor drain to sanitary sewer.

3. Laboratory equipment – refer to specification #11601

4. Eyewash stations - 15 minutes at 0.4 gal/minute;

5. Two (2) fire extinguishers

6. Smoke alarm and security system connected to the Township monitoring company, phone dialer or SCADA system.

7. A first aid kit

8. Telephone with all connection to Verizon.

R. Emergency Power

1. An emergency electrical generator capable of operating all essential plant equipment on a temporary basis shall be provided. Equipment to be operated included pumps, disinfection equipment, lights, and other pumps required to provide continuous water service.

2. The emergency generator shall be capable of all weather starts and housed in a weatherproof enclosure.

S. Wells in Carbonate Geology

1. All water supply wells located in carbonate geology as indicated by drilling log, must provide filtration, ultraviolet disinfection and chlorination as part of the treatment.

2. Continuous monitoring for turbidity and chlorine residual must be provided.

XVII. DISTRIBUTION SYSTEM

A. The distribution system shall be capable of passing peak flow without excessive frictional loss. At peak flow, pressure at each lot or unit shall be at least 30 psi. Consideration should be given to possible future expansion in the sizing and layout of the proposed piping system and for fire flows.

B. Piping shall be so valved as to allow isolation of any major section of the distribution network for repairs while still providing service to most of the system. The recommended spacing of on line gate valves is approximately 1,000 feet. Near the ends of the system, blow offs or hydrants are required to allow system flushing. The size of the "blow off" should allow high velocities to be developed in the distribution piping. Gate valves shall be provided at intersecting pipes.

C. Where possible, dead end piping shall be avoided. Near the temporary end of a main, a gate valve with mechanical restraint and/or a minimum of two full lengths of pipe on the extension side of the valve must be installed to allow future piping extension without shutting down the system, or jeopardizing the health of existing consumers. No service taps shall be allowed on a main, which can be extended in the future between the single valve to be closed and the dead end.

D. Water piping shall be bedded in sand or other appropriate material with a minimum cover of not less than 4 feet. If water main and sewer are to be installed adjacent to one another, a minimum horizontal separation of 10' 0"

must be maintained. If the minimum separation cannot be achieved, then no other protection is required if the waterline can be kept at least 18 inches above and 3 feet to one side of the sewer, and supported on a bench of original soil. If a water main must cross a sewer, the water main shall cross above with not less than 18 inches of clear separation. A single piece of cast iron water and sewer pipe is required 10 feet either side of this crossing. Water piping shall not cross under sewer piping.

E. All piping and valuing material and construction techniques shall conform to the most recent revision of the appropriate AWWA specification and Township specifications. All piping and valuing material and construction techniques shall be certified as having been manufactured and/or installed in accordance with the appropriate specifications.

XVIII. RECORD DRAWINGS

A. As built drawings shall be submitted, reviewed, and approved prior to the operational approval. The Developer shall allow for a minimum of two weeks review time for the first submittal.

B. Detailed measurements shall be made of the exact location of all buried piping, including service connections, gate valves, and blow offs. Record drawings of the distribution system shall be in accordance with Specification Section 01725.

C. A "record drawing" reproducible copy of the distribution plan with these dimensions noted shall be filed with Engineer, Township, and the entity that will operate the water system.

D. Operational approval of systems will not be made until this "record drawing" information is received by Township.

XIX. FINAL CERTIFIED INSPECTION

A. Once all other state and local approvals have been obtained a Final Inspection will be performed with the Developer, Contractor, Engineer and Township Operations personnel. If a portion of the facility is to be installed at a later date (phased with the actual growth of the development), this should be indicated at the time of original submittal.

END OF SECTION

B. Detailed measurements shall be made of the exact location of all buried piping, including service connections, gate valves, and blow offs. Record drawings of the distribution system shall be in accordance with Specification Section 01725.

C. A "record drawing" reproducible copy of the distribution plan with these dimensions noted shall be filed with Engineer, Township, and the entity that will operate the water system.

D. Operational approval of systems will not be made until this "record drawing" information is received by Township.

XIX. FINAL CERTIFIED INSPECTION

A. Once all other state and local approvals have been obtained a Final Inspection will be performed with the Developer, Contractor, Engineer and Township Operations personnel. If a portion of the facility is to be installed at a later date (phased with the actual growth of the development), this should be indicated at the time of original submittal.

END OF SECTION

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SECTION 00005

WATER DISTRIBUTION SYSTEM

DESIGN GUIDELINES

I. SCOPE

A. It is the intent of this "design criteria" section to provide sufficient detailed information to enable the Engineer for the Owner/Developer to correctly and efficiently design the overall water system for a particular development. If there is a question or a concern regarding the design of any portion of the water system that is not adequately answered within this chapter, the owner/developer or his representative shall call the Township to get all issues resolved prior to design. Any deviation from these STANDARDS AND SPECIFICATIONS must be approved in writing by the Township.

II GENERAL

A. The water system shall be designed by a professional engineer registered in the Commonwealth of Pennsylvania utilizing the most current technical standards along with good, sound engineering judgment throughout the design process. The design process includes the submittal of a utility study and construction drawings for review and approval by the Township. The following note shall be incorporated into the utility study:

"We acknowledge that the Township's review of this study is only for general conformance with submittal requirements, current design criteria, and standard engineering principles and practices.

B. Study

The Study shall include the following information and shall be bound in an 8-1/2-inch x 11-inch folder:

1. Text, which addresses, a minimum of, project location and description, project concept, discussion of any information that would affect the Township's ability to serve the new area, and any recommendations and conclusions of the analysis.

2. The area which could be served by the new water line and any pressure zones, shown on a topographic map which delineates these pressure zones.

3. The estimated population densities and total population based on land use projections, to be served by the new water line.

4. Design flow rates, minimum and maximum system residual pressures, and headloss in the distribution main.

5. A utility map that includes a minimum of the following information:

- Location of all proposed and existing easements and/or rights-of-way.
- Existing and proposed water lines and appurtenances with sizes, flows, node pressures and demands shown.
- Existing pressure zones
- All other existing and proposed utilities

III. DESIGN FLOW

A. The flows used to design the water system for a particular development vary depending on the type of development. There are two general categories of development for which flow rates are given: residential development and commercial/industrial development. Once the specific type of development is determined, the peak flows are calculated based on average demand, peak day, and peak hour factors. With each type of development, there is also a unique fire flow that shall be considered when designing the system. The Local Fire Department shall provide the required fire flows to be used in the analysis.

B. The following is a list of the criteria to be used in the preparation of all water system analyses:

1. Utility Study Criteria

a. Residential

Assume 300 gpd for all single-family residential units

Assume 225 gpd for all multi-family units, including apartments

Peak day factor - 2.5

Peak hour factor - 4.0

b. Commercial/Industrial

Average demand for planning purposes only use 1,000 gallons per day per acre

Average demand - 300 gallons/day/1,000 square foot floor area (gross)

Peak day factor - 2.5

Peak hour factor - 4.0

c. Fire Flows

To be determined by the Township's Fire Marshall

2. Analyze system for whichever is greater of the following:

a. Peak day plus fire flow, or

b. Peak hour

3. Minimum pressure 30 PSI (2nd floor of highest unit)

IV. HYDRAULIC DESIGN

A. State of the art engineering practices and techniques shall be used when analyzing and designing the hydraulics of the water system.

V. OPERATING PRESSURES WITHIN THE DISTRIBUTION SYSTEM

A. Pressure within the distribution system shall be a minimum of 50 pounds per square inch during the maximum hour demand and a maximum of 125 pounds per square inch static pressure at the main. The maximum pressure fluctuation at any location in the distribution system between maximum hour demand and minimum hour demand shall not exceed 30 pounds per square inch.

VI. PRESSURE REGULATING STATIONS

A. Pressure-reducing valve (PRV) installations are used to control pressure between distribution zones. When main extension plans are submitted for review, the need for a pressure-regulating valve installation shall be determined by the design engineer and shall be based on existing zones and the existing distribution system. Plans shall be submitted as part of the utility study indicating size, type, and location of the PRV installation. All calculations shall be submitted to the Township for review. A PRV will be required at the direction of the Township.

VII. SIZING OF MAINS

A. Distribution Mains

1. All mains shall be sized large enough to provide for domestic, irrigation, and fire protection flows to the area serviced. The maximum acceptable headloss for eight and twelve-inch mains is two feet per thousand feet of main. The minimum diameter for water mains in residential areas, including cul-de-sacs, shall be 4 inches. All schools, shopping centers, business parks, industrial parks, and high-density residential areas shall be looped with mains at least 8 inches in diameter. All waterlines shall be looped. No dead-end lines, except lines

extending into cul-de-sacs serving not more than 12 single-family residential units will be permitted.

2. The Township may require oversizing of mains, and the recovery of the costs of such oversizing shall be in accordance with the Pennsylvania Department of Environmental Protection Water Regulations.

B. Transmission Mains

1. All transmission mains shall be sized as specified by Township or according to industry best practice as determined by the AWWA.

VII. SYSTEM LAYOUT

A. General

1. All mains shall be installed in dedicated rights-of-way or public easements. Water main installation in easements between single-family residential lots will only be allowed for the purpose of looping a water main at the end of a cul-de-sac. Under no circumstances should waterlines be installed parallel to and directly below any concrete such as sidewalks, curbs, or gutters. Lines shall normally be located 5 feet north or west of street centerline, or 5 feet north or west of a curbed median, unless otherwise approved, in writing, by the Township.

2. The minimum depth of cover for water mains from the final approved grade of the surface to the top of the water main shall be 3 feet six inches. Where final grades have not been established, mains shall be installed to a depth great enough to insure 3 feet 6 inches of cover below the approved future grade. The maximum depth of cover for water mains shall be 6 feet below the final approved grade of the surface unless approved otherwise, in writing, by the Township.

3. Water mains shall be laid a minimum of ten feet horizontally from any existing or proposed utility. Upon written approval by the Township, a water main may be laid closer than ten feet to a parallel sewer main if it is laid in a separate trench and if the elevation of the invert of the water main is at least 18 inches above the crown of the sewer main and, in addition, PVC C-900 is used for the sewer main. Water mains shall be designed such that they extend the entire frontage of the property to be served or as approved by the Township.

4. When the water main passes under a highway, railroad, or waterway, there shall be a minimum of five feet of cover and a steel casing shall be installed in accordance with the detail drawing in the Appendix of these specifications. The steel casing shall extend the entire width of the right-of-way or easement of the crossing structure or as directed by the

Township. In all cases, valves shall be located such that the water main at such crossings can be completely isolated without interruption of any services.

B. Waterline Crossing Over a Sanitary Sewer Line

1. When there is less than 18 inches of vertical clearance between the water main and the sanitary sewer, the sanitary sewer shall be encased in concrete a minimum of nine feet on each side of the centerline of the crossing or polyvinyl chloride pressure pipe in accordance with American Water Works Association C900 Class 200 may be used.

C. Waterline Crossing Over a Storm Sewer Line

1. When there is less than 18 inches of vertical clearance between the water main and the storm sewer, each joint of the storm sewer within nine feet of the centerline of the crossing shall be encased in concrete.

D. Storm Sewer Line Crossing Over a Waterline

1. In all cases, regardless of vertical clearance, the joints of the storm sewer shall be encased in concrete a minimum of nine feet on each side of the centerline of the crossing.

E. Limits On Vertical Separation

1. Under no circumstances shall the vertical clearance between any lines involving a waterline, sanitary sewer line, or storm sewer is less than 18 inches without written approval from the Township.

VIII. EASEMENTS

A. All water mains shall be in an easement, which has a width of at least two times the depth to the pipe invert. The minimum easement shall be 20 feet in width for one utility, 30 feet in width for two utilities, and 40 feet in width for three utilities. Site-specific circumstances may dictate the need for wider easements. The main shall be located a minimum of 10 feet from and parallel to the edge of the easement. Fire hydrants not installed within the right-of-way will require an easement dedication ten feet wide and extending three feet behind the fire hydrant. If the fire hydrant easement is longer than ten feet, then the width of the easement shall be a minimum of 20 feet. The fire hydrant shall be centered in such easements. All easements shall be for the exclusive use of the Township. No landscaping (except grass) or permanent structures (mailboxes, sheds, buildings, etc.) shall be placed in the easement.

B. The easement agreement, provided by the Township, shall state that any temporary structures (including paving and fencing) placed in the easement shall be removed and replaced by the owner of the land when requested by the

Township so that maintenance can be performed. The owner of the land shall agree to hold the Township harmless for any replacement of structures removed from the easement and shall pay Township its out of pocket costs for removing the structure(s).

IX FUTURE CONNECTIONS

A. A temporary blow-off, in accordance with the detail drawing in the Appendix, is required at the end of any water main, which terminates and is anticipated to be extended in the future. When a future main extension is anticipated, the main shall be valved so that only one valve will have to be closed when the main is extended. The valve shall be restrained so when the one valve is closed and the line to be extended is exposed, the valve will not blow off. Restraint shall be made by the use of a mechanical joint anchoring tee (swivel tee), cross, or by installing a minimum of two full lengths of pipe on the extension side of the valve. No service taps shall be allowed on a main, which can be extended in the future between the single valve to be closed and the dead end.

X SERVICES

A. No pressure booster facility of any kind shall be allowed on any service line between the public main and the meter. All service line pressure booster facilities shall be privately owned and maintained. Water service lines shall be located a minimum of 10 feet away from all sewer services (measured horizontally). All service lines shall be constructed perpendicular to the front property line of the property they are going to serve and not more than 5 feet from the side of a front property line. All service lines and meters connected to these will be the same size.

B. All service lines 1-inch through 2-inch shall be copper and shall be installed continuously without joints between the corporation stop at the water main and the meter or curb stop. Services shall have a minimum of 3 feet 6 inches of cover and be laid as shown on the detail drawing.

C. Service connections requiring a flow greater than can be delivered through a 2-inch corporation and service line shall be 3-inch, 4-inch, 6-inch, or 8-inch connections. Service connections (3-inch, 4-inch, 6-inch, or 8-inch) to new lines shall be made with mechanical joint anchoring tees (swivel tees) or reducing mechanical joint anchoring tees (swivel tees) if installed at the time of main line construction. Later connections, if installed, may also be made with tapping sleeves and tapping valves and at the developer's expense.

XI. TRANSMISSION MAINS

A. All water mains 16 inches and larger in diameter shall be classified as "transmission mains."

B. All transmission mains shall have air and vacuum release valves installed at all high points on the line.

C. All transmission mains shall have blow-off assemblies installed at all low points on the line, constructed in accordance with the detail drawing in the Appendix.

D. No service line taps or any taps less than six inches in diameter shall be made to transmission mains. Exceptions to this will be for air and vacuum release valves only.

E. Valves on transmission mains shall be placed no more than 1,200 feet apart. Where there are connections to transmission mains, all connecting mains shall be valved at the connection. If the connection main is 16 inches or greater in diameter, there shall be a minimum of three valves at a tee connection and four valves at a cross connection.

XII. UNLAWFUL CONNECTIONS

A. No installation of potable water supply piping or part thereof shall be made in such a manner that it will be possible for used, unclean, polluted, or contaminated water, mixtures, or substances to enter any portion of such piping from any tank, receptacle, equipment, or plumbing fixture by reason of back siphonage, suction, back pressure, or any other cause, either during normal use and operation or when any such tank receptacle, equipment, or plumbing fixture is flooded, or subject to pressure in excess of the main line operating pressure. No person shall make a connection or allow one to exist between pipes or conduits carrying domestic water supplied by the Township and any pipes, conduits, or fixtures containing or carrying water, chemicals, liquids, gases, or any other substances from any other source.

XIII. APPURTENANCES

A. Valves

1. Residential distribution systems shall be valved to ensure that no more than 600 feet of main or 18 residential units and 1 fire hydrant will be out of service in the event of a single water main break. Valve placement shall be such that there are at least three valves at every tee and four valves at every cross.

2. Valves larger than 12 inches shall be butterfly valves. Main line valves shall be located at a point on the main that is intersected by an extension of the side property line of lots in the subdivision. Under no circumstances shall a valve be located in concrete areas, such as sidewalks, crosspans, aprons, curbs, or gutters. Valves located on water mains in easements shall be located at the connecting tee, cross, or elbow. Butterfly valve operators shall be located on the north or east

side of the water main. Any valve located in a open space area shall have a 12-inch wide by 12-inch thick concrete collar around the valve box.

B. Fire Hydrants

1. The maximum distance, as measured along the centerline of the street, between fire hydrants shall be 500 feet in residential areas and 300 feet in business and other high-value areas unless approved otherwise by the Township. One fire hydrant will be allowed on dead end line provided that the line is an 8" line. The number and location of fire hydrants in a given area shall be approved by the Fire Marshal. If hydrants are to be installed at locations other than street intersections, they shall be located on the extension of property side lot lines. In no case shall a hydrant be located closer than 5 feet to obstructions, driveways, etc. The fire hydrant shall be located within the right-of-way and on the same side of the street as the water main unless otherwise approved by the Township. Fences, landscaping, etc., shall in no way hinder the operation of the fire hydrant.

2. The fire hydrant lateral lines shall be set at 90 degrees to mains. The fire hydrant lateral line shall be no more than 70 feet in length from the main. No horizontal bends or offsets shall be used in fire hydrant lateral lines. Under no circumstances shall any tap be made on a fire hydrant lateral line.

C. Thrust Blocks

1. All bends, tees, plugs, dead-ends, wet taps (in certain cases), hydrants, and blow-offs shall be designed and constructed with concrete thrust blocks. If the soil-bearing strength is unknown, the soil-bearing capability used in design shall be 2,000 pounds/square foot.

D. Meter

1. Except as approved by the Township, meters shall be installed in buildings in accordance with the specifications drawings.

2. All water meters connected to the Township's utility system shall be the property of the Township. Under no circumstances shall anyone other than Township personnel remove a water meter once it has been inspected and approved. No connections shall be made in a Township-approved meter pit other than those related to the meter and bypass. Sprinkler system connections shall be made downstream from the meter unless otherwise approved by the Township.

3. For any installation where special or unusual conditions might exist, detailed drawings, accompanied by a letter of explanation, shall be submitted to the Township for review and approval.

4. Every "Master Metered" system to which fire hydrants or fire protection lines will be connected shall have a UFL approved "Fire Service Protection Water Meter" in accordance with AWWA C703. The Township shall be contacted prior to design for meter requirements.

5. For any water meter installation over 2 inches in size, detailed drawings of the proposed installation shall be submitted to the Township for review and approval prior to construction.

6. There shall be no electrical wiring allowed in any water meter pit or vault unless authorized, in writing, by the Township.

7. All meter sizes for a professional engineer registered in the Commonwealth of Pennsylvania and calculations shall determine residential, commercial or industrial use submitted to the Township for review and approval.

E. Fire Protection Service Line

1. Valves on newly constructed fire lines shall be located on the tee at the main line. The owner shall maintain all private fire lines beginning at and including this valve. All fire sprinkler taps shall be installed with an approved backflow prevention device and a flow switch, which will indicate when water has flowed through the line. A commercial or industrial property requiring a domestic service line and a fire protection service line will have separate taps for each. Residential connections for fire sprinklers shall conform to the appropriate specification drawing.

F. Valve Vaults

1. All valves larger than 12 inches shall be installed in a vault. All valve vaults shall be capable of withstanding AASHTO H-20 highway loading. The vault shall also have lift hooks in the roof for valve removal inside the vault.

2. Vaults shall be made waterproof after construction by use of sealants, epoxies or other approved methods. All vaults shall be designed with wall sleeves and link seal and be capable of handling thrusts caused by removing valves.

G. Backflow Prevention Assemblies

1. To prevent backflow contamination of the Township's potable water mains, a backflow prevention assembly shall be installed at all service connections. The assembly shall be placed downstream of the water meter and installed per Pennsylvania Department of Environmental Protection guidelines to allow for proper operation and easy access for annual testing and maintenance. Backflow Preventors are selected based on the associated or potential risk at each facility or connection with the minimum risk requirement calling for a dual check valve.

XIV. RECORD DRAWINGS

A. As built drawings shall be submitted, reviewed, and approved prior to the operational approval. The Developer shall allow for a minimum of two weeks review time for the first submittal.

B. Detailed measurements shall be made of the exact location of all buried piping, including service connections, gate valves, and blow offs. Record drawings of the distribution system shall be in accordance with Specification Section 01725.

C. A "record drawing" reproducible copy of the distribution plan with these dimensions noted shall be filed with the Township, and the entity that will operate the water system.

D. Operational approval of systems will not be made until this "record drawing" information is received by Township.

XV. FINAL CERTIFIED INSPECTION

A. Once all other state and local approvals have been obtained a Final Inspection will be performed with the Developer, Contractor, Engineer and Township Operations personnel. If a portion of the facility is to be installed at a later date (phased with the actual growth of the development), this should be indicated at the time of original submittal.

END OF SECTION

OIL AND GREASE INTERCEPTOR

DESIGN GUIDELINES

I. GENERAL

A. This section includes guidelines for design and installing a sand, oil and grease interceptor

B. All interceptors or traps shall be of a type and capacity approved by the Township and shall be located so as to be readily and easily accessible for cleaning and inspection. All interceptors shall be supplied and properly maintained continuously in satisfactory and effective operation by the Owner at his expense."

C. Buckingham Township prohibits the discharge to sewer collection system of "any wastewater containing fats, wax, grease or oils, of animal or vegetable origin (whether emulsified or not), in excess of 100 mg/l or containing substances which may solidify or become viscous at temperatures between 32ºF and 150ºF, without prior approval of the Township."

D. It is the intent of this Buckingham Township Grease Trap Standard to provide for specific standards for grease trap location, design, installation, construction, operation and maintenance so as to comply with the above requirements

II. DEFINITIONS

A. All definitions shall be as currently supplied in the existing Buckingham Township Wastewater Standards with the following additions:

1. Food Service Establishment

Any commercial facility discharging kitchen or food preparation wastewaters including restaurants, motels, hotels, cafeterias, hospitals, schools, bars, etc. and any other facility which, in the Township's opinion, would require a grease trap installation by virtue of its operation. Such definition normally includes any establishment, which is required to have a Bucks County Department of Health food service license.

2. Grease Trap/Grease Interceptor

The device, which is utilized to affect the separation of grease and oils in wastewater effluents from food service establishments. Such traps or interceptors may be of the "outdoor" or "underground" type normally referred to as large grease interceptors, or the "under-the-counter" package units normally referred to as the smaller grease traps. However, for the purposes of this Standard, the words "trap" and "interceptor" are generally used interchangeably.

III. GENERAL REQUIREMENTS

A. The following administrative, operational, and other general requirements are applicable to all food service establishments, new or existing. Particular requirements for grease trap/interceptor construction, specifically pertaining to both new and existing food service establishments, can be found in Section D of this Standard.

1. All food service establishments in Buckingham Township sewer service area shall have grease-handling facilities approved by Buckingham Township. Establishments whose grease handling facilities are not in accordance with this Standard shall be given a compliance schedule with a deadline not to exceed three (3) months from initial notification date.

2. All food service establishment grease handling facilities/operations shall be subject to review, evaluations, and inspections by Buckingham Township representatives at a minimum of one-year intervals. Results of inspections will be made available to facility owners, with overall ratings assigned and recommendations for correction/improvement (if necessary) delineated.

3. Any facility receiving three (3) consecutive unsatisfactory evaluations shall be subject to penalties/restrictions as provided for in the Buckingham Township for non-compliance with theses standards.

4. Violations of this Buckingham Township Grease Trap and Grease Interceptor Standard will be considered grounds for discontinuance of water and/or sewer service.

5. Food service establishments whose operations cause or allow excessive grease to discharge or accumulate in the sewer collection system are liable to Buckingham Township for all costs related to Buckingham Township service calls for line blockages, line cleanings, line and pump repairs, property damages, etc. including all labor, materials, equipment, and overhead. Failure to pay all service-related charges may also be grounds for water and/or sewer service discontinuance.

6. Maintenance

a. Grease shall be removed or cleaned from such interceptors at a frequency determined by Buckingham Township, but in no case at an interval greater than once per ninety (90) days. The entire contents (grease, liquid, settled material) shall be removed or cleaned from the interceptor once per year. All costs for removal of material or cleaning of the interceptor shall be at the user's expense.

b. The generator shall prepare an internal log for the grease traps to document the cleaning and keep copy on site for a minimum of three (3) years. It is always the responsibility of the generator to ensure that the generator section of the manifest is complete and accurate and the date of the cleaning clearly marked.

c. Maintenance contracts and/or records of grease removal frequencies for grease handling facilities may be required at the discretion of the Buckingham Township to be submitted periodically to ensure routine and adequate system maintenance.

d. In the maintaining of the grease interceptors, the Owner(s) shall be responsible for the proper removal and disposal by appropriate means of the captured material and shall maintain on site records of the dates, and means of disposal, which are subject to review by the Buckingham Township. Currently licensed waste disposal firms must perform any removal and hauling of the collected materials not performed by Owner(s) personnel.

7. Any food service establishment whose effluent is suspected or perceived by the Buckingham Township to contain a concentration of greater than 100 mg/l of oil and grease may be required to routinely sample their grease trap effluent and have it analyzed for oil and grease at the expense of the Owner and furnish a copy of the analysis to Buckingham Township.

8. All grease traps/interceptors shall be designed, installed and located in accordance with this Standard to allow for complete access to inspection, maintenance, etc.

9. All grease traps/interceptors must be installed by properly licensed plumbing contractors.

IV. CONSTRUCTION STANDARDS

A. New Facilities

1. All newly constructed (or newly located) food service establishments shall be required to install a grease interceptor, approved by Buckingham. Grease interceptors shall be sized at 20 gallons per food service seat, with no interceptor less than 1,000 gallons total capacity, (unless such interceptors are not feasible to install).

2. New facilities are required to complete an initial grease trap application to install a grease trap and submit such application with plans,

specifications, plumbing diagrams, riser diagrams, etc. to Buckingham Township for review

3. All grease trap/interceptor plans and specifications must be reviewed and approved by the Buckingham Township prior to installation. An approval letter for each new trap will be issued by Buckingham Township prior to construction and/or installation.

4. The construction and location criteria for grease interceptors shall be in accordance with Environmental Protection Agency (EPA) Guidance Document, "On site Wastewater Treatment and Disposal Systems," Chapter 8. Typical construction detail drawings for acceptable grease traps located in the Details Section of the Standards.

5. All grease interceptors, whether singular or in series, must be directly accessible from the surface and must be fitted with an extended outlet sanitary tee that terminates 6" to 12" above the tank floor. The minimum access opening dimensions shall be 18" x 18" or a minimum of 24" in diameter. Two (2) access openings (inlet and outlet) to underground traps are required and should be removable with ease by one person.

6. All below ground grease interceptors must either be two-chambered or individual tanks in series. If two-chambered, the dividing wall must be equipped with an extended elbow or sanitary tee terminating 6" to 12" above the tank floor. An extended outlet sanitary tee must also be provided at the outlet of the second chamber. Both chambers must be directly accessible from the surface. See Detail S-16 for 1,000-gallon capacity traps

7. Above criteria (1 thru 6) apply primarily to outdoors type (underground) grease trap units.

8. Maintenance of grease traps/interceptors must include thorough pump-out and/or cleaning as needed, with a minimum frequency of four (4) times per year. Maintenance contracts may be required to be submitted to the Buckingham Township as called for in Section III, Paragraph E of this Standard. The Owner, however, is ultimately responsible for the proper maintenance of the grease trap facility.

9. No new food service facility will be allowed to discharge into the collection system until grease-handling facilities are installed and approved by the Buckingham Township.

10. For cases in which underground type grease interceptors are not feasible to install, new food service establishments will be required to install adequate and approved "under-the-counter" grease traps for use on individual fixtures, including pot sinks, mop sinks, pre-rinse sinks,

wok ovens, floor drains, and other potentially grease containing drains. In such cases, units will be considered acceptable only if approved flow control fittings are provided to the grease interceptor inlet to prevent overloading of the grease trap and to allow for proper interceptor operation.

11. Approved manufacturers shall include Zurn, Rockford, Thermaco, or equal as approved by Buckingham Township. Buckingham Township approval of flow control devices and grease trap design must be given prior to installation. Dishwashers and garbage grinders shall not be piped directly to under-the-counter or underground type grease traps without prior Buckingham Township approval.

B. Existing Facilities

1. All existing food service establishments (or renovated or expanded establishments) shall have grease-handling facilities approved by Buckingham Township. Food service establishments without any grease handling facilities will be given a compliance deadline not to exceed three (3) months from date of notification to have approved and installed grease handling equipment in compliance with this Standard.

2. For cases in which "outdoor" units are feasible to install, construction requirements will be as specified in Section IV Paragraph A of this Standard, i.e. New Facilities.

3. Sizing of "under-the-counter" grease trap units will be in accordance with (EPA) recommended ratings for commercial grease traps, attached to this Standard. The grease retention capacity rating in pounds shall be at least two (2) times the gpm flow rate of the type fixture which it serves.

4. Location of "under-the-counter" units must be as close to the source of the wastewater as physically possible, while remaining accessible for maintenance.

5. Wastewater from dishwashers and garbage grinders should not be discharged to grease traps/interceptors, unless approved by Buckingham Township in advance.

6. In the maintaining of existing grease traps/interceptors, the Owner(s) shall be responsible for the proper removal and disposal by appropriate means of the captured material and shall maintain records of the dates and means of disposal which are subject by the Buckingham Township.

7. In the event of an existing food service establishments grease handling facilities are either under designed, substandard, or poorly operated, the Owner(s) will be notified, in writing, of the required improvements

and given a compliance deadline not to exceed three (3) months to conform to the requirements of this Grease Standard.

8. Exclusive use of enzymes or other grease solvents, emulsifiers, etc. in lieu of physical cleaning is not considered acceptable grease trap maintenance practice.

9. Grease consuming bacteria may be considered for interim approval for grease trap maintenance, provided approval is obtained from Buckingham Township and providing that this control method is considered effective and satisfactory to Buckingham Township inspector. Exclusive use of bacteria (in lieu of physical cleaning) may not be sufficient for long-term grease trap maintenance, especially for non-biodegradable waste fractions.

C. New Food Service Establishments in Existing Buildings

1. Where practical, new food service establishments locating in existing buildings will be required to comply with the Grease Trap Standards applicable to new facilities, i.e., outdoor type grease trap units (minimum size 1,000 gallons) shall be installed.

2. Where physically impossible to install "outdoor" units, "under-the-counter" units may be allowed as with existing food service establishments provided prior approval of unit type, size, location, etc. is approved by Buckingham Township. Flow control fittings and/or automatically cleaned units will be required in all cases. Maintenance contracts and/or clean-out records will also be required.

V. OIL AND GREASE INTERCEPTOR

A. Provide precast concrete vault.

1. 5000 psi concrete.

VI. LOCATING

A. Easily accessible for cleaning and solids removal.

1. Remove solids when approximately 75% of the interceptor’s capacity is reached.

VII. MANHOLE FRAMES AND COVER

A. Acceptable Products

Manhole inlet frames and covers shall be equal to those specified below, modified to provide the specified features.

1. Watertight manholes shall be Neenah Model No. R-1916-F, self sealing, gasketed and lids bolted with (4) 3" long stainless steel bolts

B. Unless otherwise specified, manhole frames and covers shall be the heavy-duty type designed for H-20 highway loading, shall have a 24-inch clear frame opening and a minimum frame height of 4 1/2 inches and shall be equipped with a continuous-ring type gasket designed to minimize surface water inflow.

C. Cover pattern shall be shall be made accurately to the pattern and dimensions specified and shall be furnished with flat true surfaces. Words "SEWER - DANGER-KEEPOUT" along with Buckingham Township shall be cast in each cover and shall have concealed or closed pick holes with sufficient dimensions to allow for removal without special equipment. Bearing and wedging surfaces shall be machined to ensure a tight fit and to prevent rocking. Frames shall be provided with four 1-inch diameter holes for anchor bolts. The use of salvaged or scrap materials will not be permitted.

D. Covers shall be provided with a continuous, machined groove on either the underside bearing lip or the outer wedging edge of the cover. A groove on the bearing lip shall be fitted with a glued, continuous, low compression, set gasket; a groove on the outside edge shall be fitted with a neoprene O-ring seal.

E. Locking type, non-gasketed frames and covers shall be provided where specified. Locking covers shall have two locking wedges in the frame. Covers shall have two fingers that engage the locking wedges when the cover is positioned in the frame and turned.

VIII. ENFORCEMENT

A. Enforcement of this Standard shall be in accordance with the provisions of the most current Buckingham Township User Regulations. Failure to comply with this Standard may be grounds for penalty imposition and/or discontinuance of water and/or wastewater service.

B. For new food service establishments, the Authority may elect to request from the appropriate Buckingham Township Code Enforcement Officer that certificates of occupancy be withheld until compliance with Buckingham Township requirements, including grease trap compliance is fully met.

I. RECOMMENDED RATINGS FOR COMMERCIAL "UNDER-THE-COUNTER" PACKAGE UNIT GREASE TRAPS/GREASE INTERCEPTORS

Type of Fixture	Flow Rate GPM	Grease Retention Capacity Rating LB	Recommended Maximum Capacity Per Fixture Connected to Trap GAL
Single compartment scullery sink	20	40	50.0
Double-compartment scullery sink or triple compartment sink	25	50	62.5
(2) single compartment sinks	25	50	62.5
(2) double compartment sinks	35	70	87.5
Wok ovens	15	30	50
Other fixtures	"	"	"

Note: For multiple fixtures served by one tap, the required grease trap capacity will be additive. As determined by Buckingham Township

END OF SECTION

SECTION 00008

RESIDENT PROJECT REPRESENTATIVE (OBSERVER)

I. GENERAL

A. One or more full time Resident Project Representatives (Observers) may be furnished and directed by the Engineer or Township in order to provide more extensive representation at the project site during the construction phase. The Developer or owner of the inspected project will pay for such resident project representation.

B. The Township's Observer may inspect all construction and materials and may also inspect preparation, fabrication or manufacture of components, materials and supplies. The RPR is not authorized to revoke, alter or waive any requirements of the specifications, but is authorized and expected to call to the attention of the Developer and/or Contractor any failure of work or materials to conform to the plans or specifications. The RPR shall have the authority to reject materials or suspend the work until questions of issue can be referred to and decided upon by the Township Manager or his designated representative.

C. The RPR shall in no case act as foreman or perform other duties for the Engineer and/or Contractor or interfere with the management of the work. Advice that the RPR may give shall in no way be construed as binding to the Township or releasing the developer, his Engineer or Contractor from performing according to the intent of the plans and minimum Township Standards.

D. All work that has been rejected or condemned shall be repaired, or if it cannot be satisfactorily repaired, shall be removed and replaced at the Contractor/Developer's expense. Materials not conforming to the requirements of the specifications shall be removed immediately from the site of work and replaced with satisfactory material by the Contractor/Developer, at his expense. The Township shall have the right to require additional inspections, certification and/or testing to confirm that the deficient work has been corrected.

E. Inspections shall be scheduled for regular working hours only, except for nights when service disruptions are involved. Scheduled inspections are required for jackings and borings and pipe slippage through same, setting of wet wells, lift station start-ups with manufacturer's representative present and any time an existing Township facility is to be connected (i.e. manhole tie-in and water or sewer taps). Work will not be scheduled for weekends or holidays.

F. When progress of the project requires the periodic presence of a Township Representative during non-normal working hours, for the convenience of the Contractor, the Contractor/Developer shall accept the financial responsibility for the overtime hours (at overtime rates) with a minimum of four (4) hours,

including travel time. This shall include work done on holidays, weekends, or other non-scheduled work hours.

G. The Township must be provided with at least two (2) full working days notice for scheduled inspections. Observer will make unscheduled visits as needed to inspect such items as materials on site and clearances between conflicting lines.

H. Contractor shall at all time keep Engineer fully advised of the number of crews he is currently employing and will continue to employ. Contractor shall advise Engineer prior to starting additional crews so that sufficient time will be allowed to secure additional personnel.

I. It shall be the responsibility of the Developer's Contractor to schedule inspections and their qualified representative shall be present at all scheduled tests and inspections. A scheduled inspection will be canceled if the representative is not present. The Developer's Contractor shall pre-test all systems not connected to Township's systems to minimize failures during the observed tests. The Developer's professional land surveyor shall prepare accurate record drawings that shall be submitted to the Township two (2) days before any tests or inspections. In any case, record drawings must be submitted prior to service being provided to any phase of a project.

END OF SECTION

DIVISION 1

GENERAL REQUIREMENTS

Castle Valley Consultants, Inc.
Engineers • Planners • Design Professionals
10 Beulah Road, New Britain, Pa. 18901
Phone (215) 348-8257 Fax (215) 348-8267
Web: www.casval.com

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SECTION 01000

GENERAL

PART 1 GENERAL

1.01 INTENT OF SPECIFICATIONS

A. These specifications establish standards and methods necessary for the design and installation of sanitary sewers, water distribution lines and appurtenances as well as wastewater treatment and disposal and water supply facilities.

B. If any material and/or equipment installed is found not to be in accordance with these specifications, the developer or his contractor will correct, or remove and reinstall all unsatisfactory material and/or equipment to the satisfaction of Buckingham Township prior to, and for a period of eighteen (18) months after, final acceptance by Buckingham Township.

C. Approval drawings and related certifications for all material and equipment involved with sanitary sewer and water system construction must be submitted to the Engineer for approval at least thirty (30) days prior to ordering that material or equipment. Any change orders involved with sanitary sewer and water system construction must be approved by Buckingham Township prior to execution.

D. If these specifications do not, in the opinion of the Engineer, satisfactorily describe materials and/or equipment and/or methods, then the Standards and Specifications of the American Water Works Association (AWWA), most recent edition, shall govern.

E. It is acknowledged that these specifications represent the best descriptions and technologies available at their adoption. Improved technologies will be reviewed by Engineer and Township Water and Wastewater Department Director of Operations and may be substituted provided both approve. These specifications may be amended ate any time and from time to time by a resolution of the Board of Supervisors.

1.02 DEFINITIONS

A. Whenever in these specifications the following terms, or pronouns in place of them are used, the intent and meaning shall be interpreted as follows:

1. Contractor - Party hired by the Owner/Developer to construct or perform work, acting directly or through his agents or employees. The Contractor, if a corporation foreign to the Commonwealth of Pennsylvania, must be qualified to do business in the Commonwealth of Pennsylvania pursuant to current laws

2. Engineer – The Buckingham Township Water and Sewer (W&S) Engineer – currently Castle Valley Consultants, Inc., 10 South Clinton Street, Doylestown, Pennsylvania 18901. In the event said firm ceases to serve as W&S Engineer for Buckingham

Township, an engineering firm or professional engineer chosen by Buckingham Township.

3. Indicated - Shall mean "indicated on the drawings."

4. Laboratory – The official testing laboratory of Buckingham Township, as may be selected by the Engineer, with the approval of, the Owner and Buckingham Township.

5. Notice - The term "Notice," as used herein, shall mean written notice. Written notice shall be deemed to have been duly served when delivered to or at the last known address (business) of the person, firm or corporation for whom intended, or to his, their, or its duly authorized agent, representative or officer or when enclosed in a postage prepaid wrapper or envelope addressed to such person, firm or corporation at his, their or its last known address *and* deposited in a United States Mail box.

6. Observer or Resident Project Representative - The authorized representatives of Buckingham Township and/or Engineer assigned to make any or all necessary observation of work performed and materials furnished by the Contractor.

7. Owner/Developer - Person, partnership, municipality or firm for whom and upon whose land construction is taking place.

8. Plans or Drawings - All drawings, or reproductions of drawings, approved by Buckingham Township pertaining to construction within a particular subdivision or work area.

9. Provide - Shall mean "furnish and install" or "furnish labor and material required for installation of."

10. Specifications - The directions, provisions and requirements contained herein, pertaining to methods and manner of performing work, or to quantities and qualities of materials to be furnished.

11. Sub-contractor - An individual, firm or corporation, who contracts with a Contractor to perform part or all of the latter's contract.

12. Township - Buckingham Township - PO Box 413 Buckingham, PA 18912.

13. Work - The term "Work," as used herein, refers to all work at the project site and includes all labor, materials, supplies, equipment, and other facilities and things necessary or proper for or incidental to carrying out and completing terms of these Specifications. The term, "Work Performed" shall be construed to include material delivered to and suitably stored at the project site.

END OF SECTION

SECTION 01010

GENERAL EQUIPMENT AND MECHANICAL REQUIREMENTS

PART 1 GENERAL

1.01 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

American Gear Manufacturers Association (AGMA)

American Institute of Steel Construction (AISC)

Hydraulic Institute

National Electrical Manufacturers Association (NEMA)

Occupational Safety and Health Act (OSHA)

1.02 SUMMARY

A. Section Includes: The general requirements for all of the Equipment and Mechanical work in the scope of the Project, included in Divisions 11, 12, 13, 14 and 15, and elsewhere wherever specifically mentioned in these Specifications.

B. Direct the attention of all subcontractors and suppliers of equipment and related appurtenances for the work to the applicable provisions in the Contract Documents wherever they may occur.

1.03 STANDARDS FOR THE WORK

A. Complete Systems: Provide pipe, fittings, wiring and supports to produce complete, operable systems with all elements properly interconnected. If a specific dimensioned location is not shown for interconnections or smaller system elements, select appropriate locations and show them on Shop Drawing submittals for review.

B. Provide equipment and material new and without imperfections. Erect in a neat and workmanlike manner; aligned, leveled, cleaned and adjusted for satisfactory operation; installed in accordance with the recommendations of the manufacturers and the best standard practices for this type of work so that connecting and disconnecting of piping and accessories can be readily made and so that all parts are easily accessible for inspection, operation, maintenance and repair. Locate oil and lubrication fittings clear of and away from guards, base,

and equipment and within reach from the operating floor. Coordinate location of all motor connections in order to properly orient encased electrical conduits.

C. The recommendations and instructions of the manufacturers of products used in the work are hereby made part of these Specifications, except as they may be superseded by other requirements of these Specifications.

1.04 SUBMITTALS

A. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

1. Submit Shop Drawings and receive approval prior to fabrication, construction or delivery to the project site in accordance with Section 01300 of these Specifications. Show sizes and arrangement of equipment, foundations and anchor bolts required, performance characteristics, fan curves and pump curves, control diagrams, wiring diagrams, motor data sheets, methods of assembly, pipe hanging details, ductwork layouts and connections to other work. Date and sign drawings as certified for use in construction of this project. The arrangement of mechanical equipment and appurtenant piping shown on the Drawings may be varied as necessary to fit the approved certified manufacturer's installation drawings. However, manufacturers' drawings shall not deviate in substance from the Contract Drawings and Specifications as to location, size, type and design of equipment.

2. The following minimum requirements shall accompany all equipment submissions:

a. Overall dimensions.

b. Mounting arrangement and dimensions.

c. Description of materials.

d. Connection sizes and orientation.

e. Capacity and location of lifting eyes.

f. Motor arrangement showing location of electrical connections.

g. Rating data - Mechanical and Electrical as applicable.

h. Detail electrical wiring diagrams, showing component designation and rating.

i. Anchorage requirements.

j. List of special tools and/or spare parts to be furnished, if any.

3. Manufacturers' Affidavits

Manufacturers' Affidavits: Where called for in the Specifications, each equipment manufacturer, or his authorized representative, shall submit an affidavit.

4. Performance Tests

Each piece of equipment, for which certified witnessed or non-witnessed performance tests are required, shall be accompanied by a completed form containing at least the following information:

a. Owner's name and location of project.

b. Contractor's name and subcontractor if applicable.

c. Name of item being submitted.

d. Specification reference by section, paragraph and page.

e. Data on item (manufacturer, general descriptive data, dimensions, size of connections, speeds, performance curves, serial number). A specific list of the test results plus a list that shows all values that differ from Specifications.

f. Motor data, type, voltage, frequency, phase, full load amperes, starting method, frame size, enclosure insulation type (NEMA Code letter), dimensions, service factor, serial number.

g. Date and signature of person certifying the performance.

1.05 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 01730.

B. Operation Data: Provide operating data for specified equipment.

C. Maintenance Data: Provide lubrication and periodic maintenance requirements and schedules.

1.06 QUALITY ASSURANCE

A. Perform work in accordance with Section 01400.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle equipment according to manufacturer's instructions and the provisions of Section 01600.

1.08 SCHEDULING AND COORDINATION

A. Schedule work under the provisions of Section 01300.

B. Coordinate the delivery and installation of the work of this section with the work of other sections.

1.09 WARRANTY

A. The manufacturer shall provide a warranty against any defect or malfunction due to workmanship in the equipment and accessories for a period equal to the maximum industry standard from date the system is put into service.

B. A written manufacturer's warranty shall be supplied.

C. Submit a written warranty and guarantee on Contractor's letterhead restating the terms of the warranty and guarantee on equipment.

1.09 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 01725.

B. Record actual locations of pipes, utilities, equipment and accessories.

1.10 RESPONSIBILITY AND CARE OF EQUIPMENT

A. The Contractor shall be responsible for the equipment included in this Contract until it has been finally inspected, tested and accepted in accordance with the requirements of these Specifications.

B. The Contractor shall make his own provisions for properly storing and protecting all material and equipment against theft, injury or damage from any and all causes. Damaged material and equipment shall not be used in the work.

PART 2 PRODUCTS

2.01 DESIGN

A. General: Design all equipment for the service intended, of rugged construction, of ample strength for all stresses which may occur during fabrication, transportation, erection and during continuous or intermittent operation. Adequately stay, brace and anchor, and install equipment in a neat and workmanlike manner. Give consideration to appearance and safety, as well as utility, in the design of details. Use cathodically compatible materials of construction.

B. Controls: Unless noted otherwise, the design of the electric control of any equipment system and/or equipment package shall be the responsibility of the manufacturer of the equipment system and/or equipment package. The elementary control diagrams as shown on the Electrical Drawings and the diagrams shown on the Instrumentation Drawings are illustrative of control and monitoring requirements pertaining to various equipment of this project. The manufacturers shall design their own functional electric control devices and

circuitry, in consultation with the specific elementary control diagrams and other project specifications, to meet the equipment control requirements. The equipment manufacturer shall furnish all such systems and package controls, except that controls shown in motor control centers and process controllers, remote control devices, and their interconnecting wiring shall be provided under Divisions 13 and 16. Provide heating and ventilating controls, both 24-volt and line voltage type, by a HVAC controls specialist.

2.02 MATERIALS AND STANDARD SPECIFICATIONS

A. Materials: Design, fabricate and assemble equipment and systems with new materials and in accordance with acceptable modern engineering and shop practices. Manufacture individual parts to standard sizes and gauges so repair parts can be installed in the field.

B. Uniformity: Unless otherwise specified, equipment or material of the same type or classification used for the same purpose shall be the product of the same manufacturer and shall be the same model.

2.03 LUBRICATION

A. Provide lubricants of types recommended by equipment manufacturers, in quantities sufficient for consumption prior to completion, testing and final acceptance.

2.04 STRUCTURAL METAL FRAMING

A. Details of fabrication shall be in accordance with Section 05120.

2.05 EQUIPMENT BASES AND BEDPLATES

A. Mount equipment assemblies on a single heavy cast iron or welded steel bedplate unless otherwise shown or specified. Provide bases and bedplates with machined support pads, tapered dowels for alignment or mating of adjacent items, adequate openings to facilitate grouting, and openings for electrical conduits. Round or chamfer and grind smooth all corners.

B. Continuously weld seams and contact edges between steel plates and shapes, and grind welds smooth. Do not support machinery or piping on bedplates other than that which is factory installed. Provide jacking screws in equipment bases and bedplates to aid in leveling prior to grouting. Mount all equipment bases and baseplates on reinforced concrete pads at least 3 inches high.

2.06 ANCHORS

A. Each equipment manufacturer shall furnish an anchor bolt pattern and the required anchor bolts, nuts and washers of adequate design for securing bases

and bedplates to concrete bases. Provide anchor bolts of length to allow for 1-1/2 inch of grout under baseplates and adequate anchorage into structural concrete unless otherwise shown or specified.

B. Provide anchor and assembly bolts and nuts of ample size and strength for the purpose intended. All bolts shall be standard machine bolts, with cold pressed hexagon nuts. Provide suitable degauling compounds for bronze and stainless steel threaded components. Any space wholly or partially underground, or having a wall or ceiling forming part of a water channel, is classified as a moist location. Unless otherwise specified or noted on the Drawings, provide materials as follows:

1. Bolts and nuts in submerged locations or submerged and embedded in concrete or buried in earth: Type 304 stainless steel.

2. Bolts and nuts for supports or equipment in dry or moist locations: Galvanized steel (hot-dipped), with oversize nuts.

3. Use other bolting materials where specifically called for in the Specifications or on the Drawings.

C. Anchor all motor-driven equipment with cast-in-place anchor bolts or drilled-in anchors set with epoxy adhesive. Do not provide expansion type anchors for motor-driven equipment.

D. Anchor all non-motor-driven equipment with cast-in-place anchor bolts or drilled-in anchors set with epoxy adhesive except that, where specifically allowed by note on the Drawing, expansion type anchors may be used.

E. Refer to technical specification requirements of drilled-in anchors set in epoxy adhesive and for expansion bolt anchors.

2.07 SAFETY GUARDS

A. Cover belt or chain drives, fan blades, couplings, nip points, exposed shafts and other moving or rotating parts on all sides with safety guards conforming to all Federal, State, and local codes and regulations pertaining; conform to the most restrictive requirement. Design guards for easy installation and removal, complete with necessary supports, accessories, and fasteners, all hot-dip galvanized. Design guards in outdoor locations to prevent entrance of rain and dripping water. Provide tachometer test opening in line with ends of shafts. Typically guards shall be expanded metal on a structural steel frame except that outdoor guards may be of solid material. Provide hinged doors with latch for service and lubrication access.

B. Cover all pipes, manifolds, heaters, and other surfaces, which have a surface temperature sufficient to burn human tissue with a thermal insulating material or otherwise guard against contact.

C. Guards to comply with OSHA.

2.08 LIFTING EYES

A. Supply all equipment weighing over 100 pounds with lifting eyes. Parts of equipment assemblies, which are normally serviced separately, such as motors, to have lifting eyes of their own.

2.09 DRIVES

A. General: Provide all drive units with a American Gear Manufacturers Association (ALMA) rating and service factor suitable for 24 hours per day operation under the operating load.

B. Electric Motors: Conform to the requirements of the Electrical Specifications.

C. V-Belt Drives: Equip each V-belt drive with suitable tension adjustment. Provide drives having a service factor of at least 1.6 with arc length correction at maximum torque using nameplate rating of driving motor.

2.10 NAMEPLATES

A. Conform to applicable requirements of Section 15190

B. Manufacturer's Nameplate: Furnish each piece of equipment and its driver with a corrosion-resistant metal nameplate fastened to the item in a readily readable position. This nameplate to contain the manufacturer's name, equipment rating, capacity, size, model, serial number and speed. All information written or printed in English.

C. Direction of Rotation: Furnish each piece of rotating equipment with a direction of rotation arrow.

D. Functional Identification: Label each piece of equipment using a plastic laminate label with the functional name and number of the equipment.

2.11 PROTECTION AGAINST ELECTROLYSIS

A. Where dissimilar metals are used in conjunction with each other, provide suitable insulation between adjacent surfaces so as to eliminate direct contact and any resultant electrolysis. Connections of dissimilar piping materials shall utilize dielectric unions, flanges, couplings or bushings.

2.12 SPECIAL TOOLS

A. For each type of equipment to be furnished, provide a complete set of all special tools (including grease guns or other lubricating devices), which may be necessary for the adjustment, operation, and maintenance of such equipment.

2.13 FINISHES

A. Conform to applicable requirements of Section 09905 and Section 09960.

B. Factory Painting: On pumps, motors, drives, starters, control panels and other similar self-contained or enclosed components, apply a factory protective paint system unless otherwise noted. Paint or otherwise protect surfaces that are inaccessible after assembly by a method, which provides protection for the life of the equipment.

C. Shop Priming: Except where field sandblasting is required, apply one or more shop coats of metal primer on surfaces to be finish painted at the site, of sufficient thickness to protect surfaces until finished. Primer shall be compatible with finish coat.

D. Rust Preventive: Coat machined, polished, other ferrous surfaces, and non-ferrous surfaces, which are not to be painted with rust preventive compound.

2.14 NOISE AND VIBRATION

A. Mechanical and electrical equipment, as installed in this project, shall not create sound levels that are in excess of that permitted by OSHA for 8 hours per day worker exposure unless otherwise noted for the specific piece of equipment involved. If the required sound level cannot be achieved by bare equipment in its designated environment, provide sound attenuating enclosures. Sound attenuating enclosures shall have necessary ventilation to prevent equipment overheating and shall be constructed for easy removal to permit maintenance. Devices necessary for day-to-day operation shall pierce the enclosure or otherwise be accessible without need to remove the enclosure.

B. Equipment which, when operating, has obvious excessive vibrations shall be repaired or replaced as directed by the Engineer. Baseline vibration measurements shall be made where specified.

2.15 FACTORY TESTS

A. Perform factory tests for each piece of equipment where specifically called for in the section specifying that equipment. Note that factory tests are inherent in many reference standards. The requirement for a factory test in a referenced standard is hereby made a part of these Specifications. Conduct factory tests at the same speeds and other conditions at which the equipment will operate in the field, except as noted.

B. Where specifically noted, performance tests may be witnessed by the Engineer or his representative. Inform the Engineer in sufficient time to allow arrangements to be made for witness of such tests. When non-witnessed tests are performed, supply certified results.

C. Perform factory testing of pumps in accordance with the requirements and standards of the Hydraulic Institute.

D. Tests of other equipment shall conform to the requirements set forth in these Specifications.

PART 3 EXECUTION

3.01 EXAMINATION

A. Inspect each item of equipment for damage, defects, completeness, and correct operation before installing.

3.02 PREPARATION

A. Prior to installing equipment, ensure that the areas are clean. Maintain the areas in a room-clean condition during installation operations. Clean, condition, and service equipment in accordance with the approved Instruction Manuals and specific recommendations of the equipment manufacturer.

3.03 INSTALLATION

A. Structural Fabrications: Conform to the AISC Code and Specification referenced in Article "Structural Steel Fabrications."

B. Equipment: Conform to approved Instruction Manuals. Employ skilled craftsmen experienced in installation of the types of equipment specified.

Use specialized tools and equipment, such as precision machinist levels, dial indicators, gauges, and micrometers, as applicable. Produce acceptable installations free of vibration or other defects. Align and pin to common bedplate equipment and drivers connected by flexible couplings.

C. Anchor Bolts: Deliver bolts with templates or setting drawings and verify that bolts are correctly located before structural concrete is placed.

D. Base and Bedplate Grouting: Do not place grout until initial fitting and alignment of connected piping is completed. Level and align equipment on the concrete foundations, then entirely fill the space under base or bedplates with grout. Bevel exposed grout at 45-degree angle, except round exposed grout at horizontal surfaces for drainage. Trowel or point exposed grout to a smooth, dense finish and damp cure with burlap for three days. When grout is fully hardened, remove jacking screws and tighten nuts on anchor bolts. Check the installation for alignment and level, and perform approved corrective work as

required to conform to the tolerances given in the applicable Instruction Manual.

1. Make an allowance of at least 1-1/2 inches for grout under the equipment bases, whether or not shown on the Drawings. Use steel shims to level and adjust the bases. Shims may be left embedded in the grout, in which case they shall be installed neatly and so as to be as inconspicuous as possible in the completed work. Unless otherwise approved, all grout shall be a favorably reviewed non-shrink, non-metallic grout.

2. Grout: Dimensionally stable, inorganic, premixed and resistant to acids, alkalies, and salt water, and unaffected by water and oil. It shall have high strength even when used as a pourable mixture, and shall bond well with steel and cured concrete or be compatible with a suitable bonding agent, which shall then be used to affect the bond. Use in strict accordance with the manufacturer's recommendations. Provide Five Star Grout as manufactured by U.S. Grout Corporation, Bonsal Construction Grout as manufactured by Bonsal Company, or equal.

3. Where practicable, place the grout through the grout holes in the equipment base and work outward and under the edges of the base and across the rough top of the concrete foundation to a peripheral form so constructed as to provide a suitable chamfer around the top edge of the finished foundation.

E. Architectural Metals: Handrails, guardrails, stairs, and other architectural metals furnished, as a part of equipment shall conform to the requirements of the applicable sections of Division 5.

3.04 EQUIPMENT STARTUP AND ADJUSTMENT

A. Arrange for an authorized factory-trained representative of the company or companies supplying the various items of equipment to check the installation and adjust and test the equipment furnished before the acceptance of the work by the Owner. Said representative shall be experienced and knowledgeable of the equipment being tested. Furthermore, he shall assist and instruct the operating staff in adjusting and operating the equipment during the initial plant operation period.

1. Provide initial lubrication for all equipment.

2. Test and demonstrate to the Engineer that all equipment operates properly and specified performance has been attained. For pumps, include measurement of suction and discharge pressure at the pump and measurement of pumping rate by volumetric means or through a

suitably calibrated meter for two points on the performance curve. For adjustable-speed pumps, conduct tests at a minimum of two speeds. Furnish any test equipment or measuring devices required which is not part of the permanent installation.

3. In addition, demonstrate that the entire facility is in full operating condition prior to the acceptance of the work. Should any equipment or part thereof fail to operate as intended, immediately remove and replace it, all at the Contractor's expense. Pay for all tests involved in this Section.

4. Pressure test equipment and connections thereto as required by these Specifications.

3.05 PERFORMANCE TESTS

A. Upon completion of the work, and after all systems are set and balanced, conduct performance tests in accordance with applicable sections of these specifications. Submit test conditions, test data and results to the Engineer.

3.06 SOUND LEVEL TESTING

A. Measure the sound level developed by all mechanical and electrical equipment provided. Perform testing in all rooms and spaces containing such equipment during the final operation test program with all equipment operating. Use OSHA approved instrument and record the highest sound level developed when measured according to OSHA standards in each room and space. Deliver a copy of records to the Engineer.

3.07 TOOLS, LOOSE PARTS, AND LUBRICANT

A. Tools and Loose Parts Supplied: Provide an inventory of tools and loose parts required to be supplied under the project. Turn over inventory and parts to the Owner. The Owner's written acknowledgment of receipt is required for project completion. Loose parts are defined as items such as special tools, keys, safety equipment, and portable equipment. Refer to relevant technical sections of these Specifications for additional instructions.

B. Recommended Spare Parts: Furnish a complete list of recommended spare parts and supplies for each equipment furnished with current prices and a source of supply.

C. Provide a list of all recommended lubricants not listed in the O&M Manuals.

3.08 OPERATION AND MAINTENANCE MANUALS

A. Provide operation and maintenance manuals where specifically called for in the Specifications.

3.09 CLEANING

A. The Contractor shall keep the equipment and premises occupied by him in a neat and clean condition.

3.10 GUARANTEE

A. The Contractor shall guarantee equipment and performance of the installation and equipment.

END OF SECTION

SECTION 01100

SPECIAL PROJECT PROCEDURES

PART 1 GENERAL

1.01 SPECIAL PROVISIONS

A. Protection of Water Supplies

In the sewer layout, a 10-foot horizontal separation of water and gravity sewer lines shall be provided. Should local conditions prevent a lateral separation of 10 feet, the gravity sewer line may be laid closer than 10 feet, but not closer than 5 feet, to a water main if the elevation of the top of the sewer pipe is at least 18 inches below the bottom (invert) of the water main, and if:

1. It is laid in a separate trench, or
2. It is laid in the same trench with the water main at one side on a bench of undisturbed earth, and
3. Approval is received from Buckingham Township.

Where sewers must cross under water mains, the sewer shall be laid at an elevation so that the top of the sewer is at least 18 inches below the bottom of the water main. When water mains are existing, and sewer elevation cannot be varied to meet this requirement, the water main shall be relocated to provide this separation, and reconstructed with ductile iron pipe for a distance of 10 feet on each side of the sewer. One full 20-foot length of water main shall be centered over the sewer so both joints will be as far from the sewer as possible.

When it is impossible to obtain proper horizontal and vertical separation as stipulated above, both water and sewer lines shall be constructed of mechanical-joint cast-iron pipe, encased in concrete and shall be pressure tested to assure water tightness.

B. Lines and Grades

In sewer construction, the Contractor must transfer line and grade to “batter boards” and string line over the trench. The Contractor may not transfer line and grade to and/or utilize a “sideline” or string set to line and grade other than over and above the centerline of the sewer to be laid. No sewer pipe shall be laid other than “up grade” or in the direction of increasing elevation of sewer grade or invert elevation unless expressly permitted by the Engineer in writing and for a specifically defined section or sections of work only. All sewer pipe shall be laid with bell ends toward the direction of increasing sewer elevation. No pipe shall be laid to line or grade unless there are at least three batter boards ahead of the last length of pipe laid in place.

In lieu of batter boards for laying pipe as specified herein, the Contractor may use a laser

beam for setting line and grade. Type of laser equipment and method of use must be approved by the Engineer.

1.01 EROSION AND SEDIMENTATION CONTROL

A. The Commonwealth of Pennsylvania Department of Environmental Protection (DEP) requires that the Contractor use all possible care to prevent siltation pollution of the waters of the Commonwealth during and after construction by implementation of an erosion and sedimentation control plan as required under Title 25, Chapter 102 of DEP Regulations. The Contractor shall conform to the Erosion and Sedimentation Control Plan Procedures and as indicated on the plan approval letters. Modifications or deviations from this plan will be allowed only if the Contractor first obtains written permission from Pennsylvania Department of Environmental Protection.

The plan of erosion and sedimentation control must be prepared and approved for implementation. It will be the Contractor's responsibility to implement this plan as work progresses and to notify all governing authorities as provided for in the plan. Construction must be well coordinated so soil disturbances will be minimal and all construction can be completed in the shortest possible time.

Some water or sewer system construction may take place in existing roadways, and some may involve clearing trees and brush along the route where adjacent trees and vegetation are to be maintained. In such cases, use of larger erosion control structures such as sedimentation basins may be prohibited. While water or sewer main construction will not permanently increase storm water runoff, absence of ground cover during construction will cause a temporary increase. Objective of this plan, therefore, is the re-establishment of vegetative growth and paving of existing or proposed roads within reasonable time after construction. Any clearing and replanting of trees and vegetation requires a plan, which must be submitted to and approved by the Township’s Landscape Review Consultant.

Where applicable, special care must be exercised to avoid damage to land adjacent to the construction area. Destruction of trees and of protective vegetation adjacent to the construction area will not be tolerated unless approved by the Township’s Landscape Review Consultant.

Constructing groundwater control devices, equipment travel, and stockpiling construction material are the most serious causes of excessive vegetation destruction. These transgressions against good erosion and sedimentation control will not be permitted.

Excavated material must be stockpiled alongside trenches away from stream channels. Flooding is less likely to move soil from the site as sediment if this practice is followed.

Temporary bridges or culverts shall be provided for machinery that must cross streams during construction. Each structure must be removed from the stream when work at that location is completed, and the streambed returned to its original condition in such manner to cause minimum siltation to the waterway. The streambed shall not be used as a roadway for moving machinery from one site to another. All work in and around streams requires a separate NPDES permit obtained by the owner or his contractor.

Provisions shall be made for protection against discharge of pollutants such as chemicals, fuels, lubricants, etc., into streams. Location of portable toilet facilities over or adjacent to streams or wells is prohibited.

If are explosives are to be used during performance of the work and/or along streams and flood plains, permits are required. Permits are obtainable from the Pennsylvania Fish Commission in Harrisburg and the Township Code Enforcement Department.

The local Waterways Patrolman must be notified when the project has begun and when explosives are to be used. The Contractor is responsible for obtaining all permits and contacting the Waterways Patrolman.

Diversion ditches shall be used whenever possible to divert upstream runoff away from erosive areas. They shall be stabilized by rock riprap on grades over five percent.

Stockpile areas shall also be selected and maintained by the Contractor. Site selections and stockpile design shall incorporate erosion and sediment control considerations. Temporary or interim stabilization of soil stockpiles shall be promptly instituted. Critical slopes on stockpiles shall be avoided. Stockpiling in or immediately adjacent to diversion channels shall not be allowed. If a stockpile is to remain for over sixty days, it shall be stabilized by soil stabilizing chemicals, temporary vegetation, interim structures, or other special practices. Temporary vegetative measures planned for implementation on stockpile areas shall be established immediately after the stockpile operation is complete. Proper mulching and soil stabilization in conjunction with these seeding operations shall also be carried out.

Pump water management is a practice that the contractor shall use to reduce production of sediment. Pump water should be discharged onto a stabilization area. If possible, it should be pumped to a storm sewer. In any event, pump water discharge onto fill slopes, fill piles, spoil slopes, etc. will not be tolerated. If ditches are required to remove pump water, they shall be stabilized with rock riprap.

After construction activity in a work area is completed, vegetation or paving on areas disturbed must be restored. If completion of construction activity does not coincide with a season in which permanent vegetation or paving can be applied, an interim or temporary program will be required. This can include soil stabilization, mulching, establishment of filters, use of scarification, or temporary paving. In any case, erosion and sedimentation controls shall be installed promptly, their maintenance assured, and no area left unprotected for more than ten (10) days following completion of construction in that area.

B. Improper construction practices prohibited include but are not limited to:

1. Operation of equipment in such manner as to contribute to stream pollution.

2. Depositing silt laden water from trenches or other excavation or allowing indirect runoff of silt-laden water into streams without sedimentation basins.

3. Disposal of trees, brush, and other debris in streams or along banks.

4. Dumping spoil materials directly into streams; or onto stream banks where they could wash or slide into streams.

5. Unnecessary removal of trees and vegetation.

C. In order to prevent siltation, the Contractor shall:

1. Familiarize himself and be responsible for carrying out all requirements of Title 25, Chapter 102 of DEP Regulations that may be required in addition to requirements set forth in this plan.

2. Construct, as directed by the Engineer, any temporary dikes or bulkheads to prevent surface water from conveying stored excavated material or newly backfilled material to any stream or storm sewer inlet. Temporary facilities shall be removed and the area restored to its original condition after construction is completed.

3. Wherever possible, not store excavated material between trenches and bodies of water.

4. Reduce by the greatest extent practicable, the area and duration of exposure of readily erosable soil. If, during the construction period, it is not possible to seed, sod or pave promptly, then mulched material shall be used in all areas other than existing streets, driveways, etc., which shall be temporarily paved.

5. Protect soils by use of temporary vegetation or seeding, or by accelerating establishment of permanent vegetation. Complete and protect segments as rapidly as is consistent with construction requirements and schedule.

6. Sprinkle or apply dust suppressors or otherwise keep dust within tolerable limits on all existing roads.

7. Should construction be suspended by any appreciable length of time, temporary measures as outlined in items 4 and 5 shall be utilized.

8. Cleanup, regrading, reseeding, and paving shall be done as work proceeds, and not left until the end of the project.

1.02 MAINTENANCE CONTROL PROGRAM

A. The Contractor is responsible to ensure that all erosion and sedimentation procedures are adhered to. During construction, the Contractor shall periodically sprinkle and fertilize in order to maintain a good vegetation cover as a permanent erosion control measure, and also clean sedimentation control devices of silt and debris, especially after heavy rainstorms. After construction, the site shall be monitored to assure that adequate vegetation cover has been established.

THE CONTRACTOR WILL BE RESPONSIBLE FOR THE PROPER CONSTRUCTION, STABILIZATION, AND MAINTENANCE OF ALL EROSION AND SEDIMENTATION CONTROLS AND RELATED ITEMS INCLUDED WITHIN THIS REPORT AND ACCOMPANYING PLANS.

1.03 PERMANENT CONTROL MEASURES

A. Permanent grass area will be established as specified on plans. Other landscaped areas will be properly stabilized after planting of shrubs or groundcover.

B. Seeded areas that have washed away will be filled or graded as necessary, and then reseeded. Straw or burlap will be placed until stabilization of the area is accomplished.

C. All exposed soil will be seeded after excavation and backfill activities.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not used

END OF SECTION

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SECTION 01111

REGULATORY REQUIREMENTS AND STANDARDS

PART 1 GENERAL

1.01 SUMMARY OF WORK

A. Building Codes and Regulations:

1. The CONTRACTOR shall perform the Contracted Work in accordance with the requirements of the Buckingham Building Codes and Amendments and all other regulations, laws, and ordinances, even though such requirements are not specifically mentioned in the Standard Specifications or shown on the Approved Development Drawings.

2. When the Work required by the Drawings and Standard Specifications are in conflict with any such law or ordinance, the CONTRACTOR shall notify the TOWNSHIP. The CONTRACTOR shall comply with the more stringent requirements, unless notified by the TOWNSHIP and the CONTRACTOR shall not proceed with the Work until the TOWNSHIP has so ordered.

3. This Section specifies procedural and administrative requirements for compliance with governing regulations, codes, and standards imposed upon the Contracted Work. These requirements include obtaining permits, licenses, inspections, releases, and similar documentation, as well as payments, statements, and similar requirements associated with the regulations, codes, and standards.

B. The procedure followed by the DEVELOPER has been to contact governing authorities, where necessary, to obtain information needed for the purpose of preparing Contract Documents, recognizing that such information may or may not be of significance in relation to the CONTRACTOR'S responsibilities for performing the Work. Direct contact, by the CONTRACTOR, with such governing authorities can be made for necessary information and decisions that have a bearing on the performance of the Work, if necessary.

C. CONTRACTOR shall be familiar with all codes, regulations and all necessary procedures to obtain and pay for all permits, arrange all inspections, and secure necessary releases or sign-offs, which are prerequisite to any utility service connection work.

D. When conflict or violation(s) of law or codes are found during any inspection by the governing agencies, the CONTRACTOR shall request such allegation of code conflict or violation, or Request of Correction to be on a written form from the

governing agencies. The CONTRACTOR shall furnish the TOWNSHIP and the INSPECTOR each a duplicate copy of such written notice for review.

1.02 REFERENCE STANDARDS

A. Applicable Publications: Whenever in these Specifications Manual references are made to published specifications, codes, standards, or other requirements, it shall be understood that wherever no date is specified, only the latest specifications, standards, or requirements of the respective issuing agencies which have been published as of the date that the Work is advertised for bids shall apply; except to the extent that said standards or requirements may be in conflict with applicable laws, ordinances or governing codes. No requirements set forth herein or shown on the Drawings shall be waived because of any provision of, or omission from, said standards or requirements.

B. Specialists' Assignments: In certain instances, specification text requires (or implies) that specific work is to be assigned to specialists or expert entities, who must be engaged for the performance of that work. Such assignments shall be recognized as special requirements over which the CONTRACTOR has no choice or option. These requirements shall not be interpreted so as to conflict with the enforcement of building codes and similar regulations governing the Work; also they are not intended to interfere with local union jurisdiction settlements and similar conventions. Such assignments are intended to establish which party or entity involved in a specific unit of work is recognized as "expert" for the indicated construction processes or operations. Nevertheless, the final responsibility for fulfillment of the entire set of contract requirements remains with the CONTRACTOR.

C. Codes and Safety Standards: Without limiting the generality of other requirements of the Specifications, all work specified herein shall conform to or exceed the applicable requirements of the following Codes and Safety Standards.

1. Applicable Codes and Standards:

Buckingham Township Building Code and Amendments

Buckingham Township "Standard Specifications for Water and Wastewater"

PADEP	Domestic Wastewater Manual
PADEP	Public Water Supply Manual
FORM 408	PennDOT Standards
EPA 625	Process Design for Land Treatment of Municipal Wastewater
AWWA	American Water Works Association

ASME	American Society of Mechanical Engineers
ASCE	American Society of Civil Engineers
ACI	American Concrete Institute
ASTM	American Society for Testing and Materials
NFPA	National Fire Protection Association
NEC	Nation Electric Code
GRI	Geosynthetic Research Institute

2. Applicable Safety Standards:

   OSHA Regulations for Construction

   OSHA Standard

   References herein to "OSHA Regulations for Construction" shall mean Title 29, Part 1926, Construction Safety and Health Regulations, Code of Federal Regulations (OSHA), including all changes and amendments thereto.

   References herein to "OSHA Standards" shall mean Title 29, Part 1910, Occupational Safety and Health Standards, Code of Federal Regulations (OSHA), including all changes and amendments thereto.

   The latest edition of the codes shall apply to the Work herein, including all addenda, modifications, amendments, or other lawful changes thereto.

D. Standard Specifications: References in the Documents to "Standard Specifications" shall mean the Standard Specifications for Water and Wastewater, including all current supplements, addenda, and revisions thereof.

E. Standard Details: References herein to "Standard Details" shall mean the Standard Details issued Buckingham Township which drawings are hereby incorporated in and made a part of these Documents, and copies of which are available for a fee.

F. Conflict Between Codes, Safety Standards, Reference Standards, Drawings And Other Documents: In case of conflict between codes, reference standards, drawings and other Contract Documents, the most stringent requirements shall govern. All conflicts shall be brought to the attention of the TOWNSHIP for clarification and directions prior to ordering or providing any materials or labor. The CONTRACTOR shall bid for the most stringent requirements.

PART 2 PRODUCTS

(NOT APPLICABLE)

PART 3 EXECUTION

3.01 PERMIT INFORMATION

A. CONTRACTOR shall contact the DEVELOPER to obtain the proper Township (owner) information to be used in the manifest or notification prior to start of any abatement work.

B. All information used by the CONTRACTOR including the Township (Owner's) and Township authorized representative's names, addresses and telephone numbers shall be consistent with the information shown on the building permit and plan-check applications obtained by the Township

END OF SECTION

SECTION 01300

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.

1.02 SUBMITTAL PROCEDURES

A. Sequentially number the transmittal forms. Resubmittals to have original number with an alphabetic suffix.

B. Identify Project, Contractor, Subcontractor or supplier; pertinent Drawing sheet and detail number(s), and specification Section number, as appropriate.

C. Apply Contractor's "approved" stamp, signed or initialed certifying that review, verification of Products required, field dimensions, adjacent construction Work, and coordination of information, is in accordance with the requirements of the Work and Contract Documents.

D. Schedule submittals to expedite the Project, and deliver to Engineer. Coordinate submission of related items.

E. Identify variations from Contract Documents, Product or system limitations, which may be detrimental to successful performance of the completed Work, shall be identified also.

F. Provide space for Contractor and Engineers review stamps.

G. Revise and resubmit submittals as required, identify all changes made since previous submittal.

H. Distribute copies of reviewed submittals to concerned parties. Instruct parties to promptly report any inability to comply with provisions.

1.03 CONSTRUCTION PROGRESS SCHEDULES

A. Submit initial progress schedule in duplicate within 15 days after date of Owner-Contractor established in Notice to proceed for Engineer review.

B. Revise and resubmit as required.

C. Submit revised schedules with each Application for Payment, identifying changes since previous version.

D. Indicate estimated percentage of completion for each item of Work at each submission.

1.04 PROPOSED PRODUCTS LIST

A. Within 15 days after date of Notice to Proceed, submit complete list of major products proposed for use, with name of manufacturer, trade name, and model number or each product.

B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

1.05 SHOP DRAWINGS

A. Sequence

1. After Pre-construction Meeting

2. Prior to Construction

B. Prerequisites

1. Pre-construction Meeting

C. Notification

1. Shop drawings are to be submitted a minimum thirty (30) days prior to start of work.

D. Responsible Parties

1. Contractor: Prepares shop drawings

2. Developer: Approves and submits shop drawings to Engineer. If the Developer wishes, he may have the Contractor approve and submit the shop drawings.

3. Engineer: Reviews and acts on shop drawings with copies of action to Township and Developer. (Three to four-day turnaround expected)

4. Township: Review and acts on any shop drawing variations from plans and Township standards. (Seven to ten-day turnaround expected)

E Process

1. All copies must be stamped by the Contractor performing the work. The stamp must include the Contractor's name, date and reference to what the shop drawing covers (i.e., raw sewage pump controls, etc.).

2. Developer shall submit for approval by Buckingham Township a minimum of six (6) copies at least 30 days prior to construction. Reviewed shop drawings will be distributed as follows:

   One (1) copy to the Contractor

   One (1) copy to the project Owner/Developer

   Two (2) copies for Buckingham Township Files

   Two (2) copies for Engineer

   If Developer/Contractor wants more returned, please submit additional copies.

3. Work on a specific item may not begin until all appropriate shop drawings have been received and approved.

4. Any variations from design drawing or Township Standards (approved construction plans) will need Engineer's and Township Water and Wastewater Operation Manager's approval in writing.

1.06 PRODUCT DATA

A. Submit the number of copies, which the Contractor requires, plus four (4) copies, which will be distributed by the Engineer.

B. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information unique to this Project.

1.07 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 or in custom colors selected, textures, and patterns for 's selection.

C. Include identification on each sample, with full Project information.

D. Submit the number or samples specified in individual specification sections; one (1) of which will be retained by Engineer.

E. Reviewed and approved samples, which may be used in the work, are indicated in individual specification sections.

1.08 MANUFACTURER'S INSTRUCTIONS

A. When specified in individual specification sections, submit manufacturers' printed instructions for delivery, storage, assembly, installation (in the quantity specified), start-up, adjusting, and finishing.

B. Identify conflicts between manufacturers' instructions and Contract Documents.

1.09 MANUFACTURER'S CERTIFICATES

A. When specified in individual specification sections, submit manufacturers' certificate to the Engineer 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 Engineer.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01400

QUALITY CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Quality assurance and control of installation.

B. References.

C. Field samples.

D. Mock-up.

E. Inspection and testing laboratory services.

F. Manufacturers' field services and reports.

1.02 QUALITY ASSURANCE/CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, Products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply fully with manufacturers' instructions, including each step in sequence.

C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Engineer before proceeding.

D. Comply with specified standards as a minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Perform work by persons qualified to produce workmanship of specified quality.

F. Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement.

1.03 REFERENCES

A. Conform to reference standard by date of issue current on date for receiving bids or the date of Owner-Contractor Agreement when there are no Bids.

B. Obtain copies of standards when required by Contract Documents.

C. Should specified reference standards conflict with Contract Documents, request clarification by Engineer before proceeding.

D. The contractual relationship of the parties to the Contract shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.04 FIELD SAMPLES

A. Install field samples at the site as required by individual specifications Sections for review.

B. Acceptable samples represent a quality level for the Work.

C. Where field sample is specified in individual Sections to be removed, clear area after field sample has been accepted by Engineer.

1.05 MOCK-UP

A. Assemble and erect specified items, with specified attachment and anchorage devices, flashings, seals, and finishes.

B. Where mock-up is specified in individual Sections to be removed, clear area after mock-up has been accepted by Engineer.

1.06 INSPECTION AND TESTING LABORATORY SERVICES

A. Contractor will employ services of an independent firm to perform inspection and testing. Contractor shall pay for services as part of bid price.

B. The independent firm will perform inspections, tests, and other services specified in individual specification Sections and as required by the Engineer.

C. Reports will be submitted by the independent firm to the Engineer, in duplicate indicating observations and results of tests and indicating compliance or noncompliance with Contract Documents.

D. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools storage and assistance as requested.

1. Notify Township Engineer and independent firm 48 hours prior to expected time for operations requiring services.

2. Arrange with independent firm and pay for additional samples and tests required for Developer's use.

E. Retesting required because of nonconformance to specified requirements shall be performed by the same independent firm or a firm selected by the Engineer.

Payment for retesting will be charged to the Contractor by deducting inspection or testing charges from the Contract Sum/Price if the tests show the work or product is not meeting the required limits.

1.07 MANUFACTURERS' FIELD SERVICES AND REPORTS

A. Submit qualifications of observer to Engineer 30 days in advance of required observations. Observer subject to approval of Engineer.

B. When specified in individual specification Sections, require material or Product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust, and balance of equipment as applicable, and to initiate instructions when necessary.

C. Individuals to report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

D. Submit report in duplicate within 30 days of observation to Engineer for review.

E. Provide to Township Engineer two copies of the "Manufacturer's Check-Out Certification."

PART 2 PRODUCTS

(Not used)

PART 3 EXECUTION

(Not used)

END OF SECTION

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MANUFACTURER'S CHECK-OUT CERTIFICATION

OWNER: Buckingham Township No. Copies ___

ENGINEER: Castle Valley Consultants, Inc. No. Copies ___

DEVELOPER: No. Copies ___

CONTRACTOR: No. Copies ___

OTHER: No. Copies ___

_____

PROJECT DATA

Name: _____

Number: _____

Date: _____

Drawing No: _____

Specification Section: _____

Name of equipment checked: _____

Name of manufacturer of equipment: _____

1. The equipment furnished by us has been checked on the job by us. We have reviewed (where applicable) the performance verification information submitted to us by the Contractor.
2. The equipment is properly installed, except for items noted below.
3. The equipment is operating satisfactorily, except for items noted below.
4. The written operating and maintenance information (where applicable) has been presented to the Contractor, and gone over with him in detail. Five (5) copies of all-applicable operating and maintenance information and parts lists have been furnished to him for insertion in each of the Equipment Brochures.

Checked By: _____ _____

Name of Manufacturer's Rep. Name of General Contractor

_____ _____

Address and Phone No. of Rep. Authorized Signature/Title/Date

_____ _____

Signature/Title/Person Making Check Name of Subcontractor

_____ _____

Date Checked Authorized Signature/Title/Date

Manufacturer's Representative Notations: Exception noted at time of check were:

_____

_____

Manufacturer's Representative to note adequacy of related equipment that directly affects operation, performance or function of equipment checked. (No comment presented herein will indicate adequacy of related systems or equipment):

_____

_____

SECTION 01410

RECORD DOCUMENTATION

PART I GENERAL

1.01 SCOPE

A. The Developer's Contractor shall provide to the Engineer as-built record documents for all work performed under the Approved Plans.

1.02 RECORD DOCUMENTS

A. Record documents refer to those documents maintained and annotated by each Contractor during construction and are defined as:

1. Neatly and legibly marked set of contract drawings showing the final location of piping, equipment, electrical conduits, outlet boxes and cables
2. Specifications annotated with addenda and change order items, by section
3. Change order documents
4. Submittals and product data
5. Field test data
6. Additional documents such as schedules, lists, drawings, and electrical and instrumentation diagrams included in the specifications
7. Contractor layout and installation drawings

B. Unless otherwise specified, record drawings shall be full size and maintained in a clean, dry, and legible condition. Record documents shall not be used for construction purposes and shall be available for review by the Engineer during normal working hours at the Developers field office. At the completion of the work, prior to final escrow release, all record documentation shall be submitted, reviewed and approved in writing by the Engineer. At this point, Engineer will request 5 sets of plans stamped “As-Built” and sealed by the Design Engineer. Three sets will be sent to the Township and 2 retained by Engineer.

C. The record documents shall be maintained continuously. Prior to each request for partial progress payment, the Engineer will review record drawings with each Contractor. Escrow releases may be reduced by as much as 15 percent if record drawings are not current.

D. Marking of the drawings shall be kept current and shall be done at the time the material and equipment are installed. Annotations to the record drawings shall be made with an erasable colored pencil conforming to the following color code:

1. Additions--Red
2. Deletions--Green
3. Comments--Blue
4. Dimensions--Graphite

E. Legibly mark to record actual depths, horizontal and vertical location of underground piping and appurtenances referenced to permanent surface improvements. The record drawings shall show field changes; changes by change order; and details not on original contract drawings.

1.03 TYPES OF INFORMATION REQUIRED

A. The horizontal and vertical data submitted shall be based on the project benchmark.

B. The horizontal and vertical data shall be supplied for manholes, gravity lines, stream crossings, road crossings, sewer lateral locations, and encountered utilities. The Record Plan information shall be supplied prior to submission of the final request for payment.

C. All drawings must be supplied on 3-1/2-computer disk using AUTO CADD Version 12 or later or compatible. Drawings must have the following layers as a minimum:

1. Water Lines
    a. Services
    b. Valves
    c. Hydrants
    d. Blow-offs and air release valves
    e. Pipe Diameter and material
2. Sewer lines
    a. Manholes
    b. Laterals – Tied in off of some permanent structure (usually the connected residence or building)
    c. Main line/pipe diameter and slope
4. Streets/Roads
5. Easements and Rights of way as recorded
6. Buildings
7. Streams
8. Contours

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

(Not Used)

END OF SECTION

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SECTION 01420

CONSTRUCTION REVIEW AND

ACCEPTANCE PROCESS

WATER SUPPLY

PART I GENERAL

1.01 PRECONSTRUCTION MEETING

A. Sequence

1. Prior to Shop Drawings

B. Prerequisites

1. Final Plan Approval
2. Executed water/sewer service agreements
3. Escrow established
4. Linens signed

C. Notification

1. Engineer (Both Township Engineer and W&S Engineer)

D. Participants

1. Township Staff
2. Engineer (Both Township Engineer and W&S Engineer)
3. Developer
4. Developer's Engineer
5. Contractor(s)
6. Others as required

E. Distribution of Plans stamped "for Construction" by Township Engineer - three (3) sets to Township staff – others as required.

1.02 PERIODIC CONSTRUCTION REVIEW

A. Sequence

1. Throughout Construction

B. Prerequisite

1. Shop Drawing Approval

C. Notification

1. Notify the following 48 hours in advance (minimum) before commencing construction.

   a. Notify Engineer.

   b. Request Township Water and Wastewater Operations Manager to turn on water before making taps and construction services.

Contractor must not operate water system valves or hydrants of systems that are operating or in use.

C. Process

1. Disinfectant must be applied to mains as they are constructed. AWWA C651-92 tablet method is to be used unless alternate is approved.

2. All taps should be made when mains are under pressure.

3. Hydrants shall be installed with the large (steamer) connection facing the street.

4. The Township will be responsible for bagging of hydrants as required.

5. Engineer shall make visits to the site at intervals appropriate to the various states of construction to observe as an experienced and qualified design professional, the progress and quality of the executed work of Contractor(s) and to determine in general if such work is proceeding in accordance with the approved plans and Township Standards. Engineer shall not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of such work. Engineer shall not be responsible for the means, methods, techniques, sequences or procedures of construction selected by contractor(s) or the safety precautions and programs incident to the work of Contractor(s). Engineer's efforts will be directed toward providing a greater degree of confidence for Township that the completed work of Contractor(s) will conform to the approved plans and Township standards, but Engineer shall not be responsible for the failure of Contractor(s) to perform the construction work in accordance with the approved plans and Township standards.

6. During such visits and on the basis of his on-site observations, Engineer shall keep Township informed of the progress of the work, shall endeavor to guard Township against defects and deficiencies in Contractor(s)' work and may disapprove or reject work failing to conform to the approved plans and Township standards.

7. Engineer will submit one copy of all site visit reports to the Township weekly.

8. Township may elect to inspect in conjunction with Engineer and advise Engineer of any deficiencies. Township inspectors shall not make or approve field changes, but rather act in an advisory capacity to Engineer who shall have final say in all such matters.

1.03 TESTING - PRESSURE

A. Sequence

1. Follow base paving

B. Prerequisite

1. All service to be installed. Testing will include service line (to curb stops).

2. Testing prior to minimum base paving is at the option of and for convenience of Developer/Contractor and is not final.

C. Notification

1. Notify Engineer at least 72 hours in advance.

2. Engineer will notify Township staff who will confirm or deny the requested time(s).

D. Process

1. The Township will flush out all dirt and debris, after three (3) days minimum disinfecting, and blow off air in all mains and services before starting pressure test.

2. Pressure test in strict conformance with AWWA Standards as adopted. This will never be less than a two-hour test at not less than 150 psig at all times during test.

3. Test equipment shall consist of a pump, a water supply (such as a tank truck) and an accurate test gauge (minimum 4-inch, 2% accuracy, and pressure snubbed or liquid filled). A water meter or calibrated tank shall be used for measuring leakage.

4. If leakage test fails, test shall be repeated as often as necessary until all parts of the installed system passes. Leakage will be calculated from drawings using AWWA Standards as adopted.

1.04 TESTING - BACTERIOLOGICAL

A. Sequence

1. Following pressure testing.

B. Prerequisite

1. Pressure testing completed.

2. Township will flush lines of chlorine residual and debris. Owner/Contractor must assure adequate dechlorination and erosion control during flushing.

C. Notification

1. Notify Township Water and Wastewater Operations Manager two weeks prior to intended use of system.

D. Process

1. Notify Township Operations Manager at least 2 weeks in advance of application for occupancy permit. The Township will collect samples and conduct the tests.

2. A satisfactory test shall be both 0 (zero) coliforms per 100 ml and a heterotrophic plate count of less than 500 per 100 ml. Water main must be re-disinfected until satisfactory test results are obtained.

3. No permanent or temporary Certificates of Occupancy will be issued without full satisfactory test reports received by the Township.

4. Township will notify Developer that test has been conducted and its results.

1.05 APPROVAL FOR USE

A. Sequence

1. Following successful bacteriological test.

2. Following preparation and completion of punch list.

B. Prerequisite

1. Successful testing completed.

2. All upstream water lines have been accepted and Township has certified that adequate capacity exists to serve the extension.

C. Notification

1. Developer notifies Engineer 14 days prior to request for occupancy permit.

2. Engineer will notify Township Water and Wastewater Operations Manager.

3. Engineer will issue recommendation to Township for acceptance by Township following successful inspection and completion of all punch list items.

4. Township will issue final acceptance letter.

D. Process

1. Final Inspection and Acceptance.

a. Streets must be paved with base and all lots at final grade near curb stops and valves.

b. Hydrants must be at the final elevation; in the right position; and in perfect operating condition.

c. Valves and valve boxes, including blow-offs and curb stops, shall be free of water and debris at final elevation. All valves must pass test for proper operation.

d. Elevation of water mains and services shall be measured from final grade and shall have a minimum of 42 inches of cover to top of pipe from grade.

e. If final inspection is satisfactory, Developer may request Township to activate system using interconnecting valves.

1.06 RECONSTRUCTION AND ADDITIONS

A. Pressure and bacteriological tests must be repeated if there are any additions or reconstruction after acceptance and prior to dedication.

1.07 APPROVAL FOR DEDICATION

A. Sequence

1. Following acceptance of facilities for use.

2. Not more than two months prior to date of anticipated dedication.

B. Prerequisite

1. Acceptance for use.

2 Completion of punch list.

3. Final Paving is in place and all grades are final.

4. Approved as-built drawings signed and sealed by Developer's Engineer.

C. Notification

1. Developer to notify Township Manager 45 days prior to date of anticipated dedication or as otherwise provided by state law.

2. Township Manager to notify:

a. Township Engineer

b. Township W & S Engineer

c. Others as deemed appropriate

D. Process

1. A pre-dedication walk-through will be conducted as follows:

   a. Coordinated by Engineer.

   b. Conducted after final paving.

   c. All valves, hydrants and other appurtenances located and operated.

   d. All valve boxes, curb boxes, hydrants shall be set at final grade with final paving and/or plantings in place.

2. Participants will be notified by Engineer and include:

   a. Township Water and Wastewater Operations Manager

   b. Contractor

   c. Developer and/or Developer's engineer

3. Punch List

   a. The Engineer will generate a draft punch list within five days of the walk-through and distribute to all participants as well as Township Operations Manager. Comments on the draft list shall be received by Engineer for five (5) subsequent days after which the punch list will be appropriately amended and issued to all participants. Punch list may be amended as deemed necessary by Engineer. If timing under the PA Municipal Planning Code is an issue, these proposed schedules will be subject to adjustment.

4. Other Requirements

   a. Legal descriptions of all easements and land to be dedicated.

   b. All other documents as noted in the Water/Sewer services agreement(s)

5. Dedication

   a. The Engineer will make a recommendation on dedication to the Township Manager detailing the punch list in order to comply with Section 510 of the PA Municipal Planning Code. Once all items are completed satisfactorily, Engineer will so notify Township with copies to Developer, Contractor.

END OF SECTION

SECTION 01430

CONSTRUCTION REVIEW AND

ACCEPTANCE PROCESS

SANITARY SYSTEMS

PART I GENERAL

1.01 PRECONSTRUCTION MEETING

A. Sequence

1. Prior to Shop Drawings

B. Prerequisites

1. Final Plan Approval
2. Executed water/sewer service agreements
3. Escrow established
4. Linens signed

C. Notification

1. Engineer (Both Township Engineer and W&S Engineer)

D. Participants

1. Township Staff
2. Township Engineer
3. Developer
5. Developer's Engineer
6. Contractor(s)
7. Others as required

E. Distribution of Plans stamped "for Construction" by Township Engineer - three (3) sets to Township staff – others as required.

1.02 PERIODIC CONSTRUCTION REVIEW

A. Sequence

1. Throughout Construction

B. Prerequisite

1. Shop Drawing Approval

C. Notification

1. Notify the following 72 hours in advance (minimum) before commencing construction.

   a. Notify Engineer.

   b. Notify Township Water and Wastewater Operations Manager before connecting to any existing facilities so that a mechanical plug can be installed by Contractor under Township supervision. Storm water/infiltration or other fluids will not be permitted to enter the sanitary sewer system during or after construction. The plug can only be removed by Contractor in the presence of Township personnel, and then only after final inspection and approval.

D. Process

1. Engineer shall make visits to the site at intervals appropriate to the various states of construction to observe as an experienced and qualified design professional, the progress and quality of the executed work of Contractor(s) and to determine in general if such work is proceeding in accordance with the approved plans and Township Standards. Engineer shall not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of such work. Engineer shall not be responsible for the means, methods, techniques, sequences or procedures of construction selected by contractor(s) or the safety precautions and programs incident to the work of Contractor(s). Engineer's efforts will be directed toward providing a greater degree of confidence for Township that the completed work of Contractor(s) will conform to the approved plans and Township standards, but Engineer shall not be responsible for the failure of Contractor(s) to perform the construction work in accordance with the approved plans and Township standards.

2. During such visits and on the basis of his on-site observations, Engineer shall keep Township informed of the progress of the work, shall endeavor to guard Township against defects and deficiencies in Contractor(s)' work and may disapprove or reject work failing to conform to the approved plans and Township standards.

3. Engineer will submit one copy of all site visit reports to the Township weekly.

4. Township may elect to inspect in conjunction with Engineer and advise Engineer of any deficiencies. Township inspectors shall not make or approve field changes, but rather act in an advisory capacity to Engineer who shall have final say in all such matters.

1.03 TESTING

A. Sequence

1. Follow base paving.

B. Prerequisite

1. All laterals to be installed.

2. Road paving (minimum base only) must be installed for final manhole testing.

3. Testing prior to minimum base paving is at the option of and convenience of Developer/Contractor. **Final testing will take place after paving**.

C. Notification

1. Notify Engineer at least 72 hours in advance.

2. Engineer will notify Township Water and Wastewater Operations Manager.

D Process

1. Sanitary sewers shall be plugged, and each section tested in accordance with Section 01440, Part 3.03. All laterals must be connected and capped. If leakage is greater than acceptance criteria, repairs must be done, then the section must be successfully retested.

2. Manholes shall be plugged then tested in accordance with Section 01440, Part 3.01. If leakage is greater than acceptance criteria, repairs must be done, followed by a retest of the manhole.

3. Force mains shall be pressure tested with water in accordance with Section 01440, Part 3.02. If leakage is greater than acceptance criteria, repairs must be done, followed by a retest of the force main.

4. Deflection test of PVC pipe shall be performed with a mandrel in accordance with Section 01440, Part 3.04. If a section is found to have excessive deflection the pipe shall be replaced.

5. A punch list will be developed following the testing. The punch list will be prepared by Township Engineer and submitted to Township for their concurrence.

1.04 APPROVAL FOR USE

A. Sequence

1. After successful testing.

2. Following preparation and completion of punch list.

B. Prerequisite

1. Successful testing of all gravity, pressure lines and manholes.

2 All downstream sewer lines, pumps and other facilities needed to provide service have been certified acceptable by Township.

C. Notification

1. Developer notifies Engineer 14 days prior to request for occupancy permit.

2. Engineer will notify Township Water and Wastewater Operations Manager.

3. Engineer will issue recommendation to Township for acceptance by Township following successful inspection and completion of punch list items.

4. Township will issue final acceptance letter.

D. Process

1. Cleaning, Flushing and Patching

a. After testing and before final inspection all sanitary manholes and sewers shall be cleaned of all debris, grit, and dirt.

b. All manholes shall be patched so that the inverts are smooth and continuous without holes, gaps or protrusions that could accumulate organics, gritty or stringy material or impede flow. Manhole frames shall be patched to achieve a watertight seal where they join the structure.

c. After cleaning and patching, all sewers shall be flushed with clean water at a flow rate of not less than 10 gpm for not less than five minutes after the stream flows clear at the last manhole.

d. The Contractor shall dispose of water at his own expense and not in an existing sanitary sewer system unless by permission of system owner.

e. Water for flushing shall be obtained by the Contractor and might be obtained from the Township, if available, with their express permission and supervision.

2. Final Inspection for Temporary or Final CO

a. All tests and cleaning must be completed satisfactorily before final inspection. However, final inspection may be concurrent with flushing.

b. Streets must be paved and manholes set in final position.

c. Contractor shall make and furnish Township two (2) copies of a VHS Format video recording of all sewers with comments digitally recorded on the screen, including the manhole run numbers.

d. If final inspection is satisfactory, the Contractor may ask the Township if he/she may remove the plug to the existing system in the presence of Township or Engineer.

1.05. RECONSTRUCTION AND ADDITIONS

A. Pressure and vacuum tests must be repeated if there are any additions or reconstruction.

1.06 APPROVAL FOR DEDICATION

A. Sequence

1. Following acceptance of facilities for use.

2. Not more than two months prior to date of anticipated dedication or as otherwise provided by state law.

B. Prerequisite

1. Acceptance for use.

2. Completion of punch list.

3. Final paving is in place and all grades are final.

4. Approved as-built drawings signed and sealed by Developer's Engineer.

C. Notification

1. Developer to notify Township Manager 45 days prior to date of anticipated dedication or as otherwise provided by state law.

2. Township Manager to notify:

a. Township Engineer

b. Township W & S Engineer

c. Others as deemed appropriate

D. Process

1. A pre-dedication walk-through will be conducted as follows:

a. Coordinated by Engineer.

b. Conducted after to final paving.

c. Owner will arrange for and have all lines pressure washed and videotaped in presence of Engineer.

d. Every manhole will be opened by the Developer and inspected by the Township and Engineer.

e. Air release valves and enclosures will be tested for proper operation and drainage.

f. All manholes and clean-outs shall be located and set to finish grade.

g. Any manhole disturbed during final paving shall be realigned and vacuum tested again.

h. Any repair work to sewer line or appurtenances shall be retested once work is completed.

2. Participants will be notified by Engineer and include:

a. Township Water and Wastewater Operations Manager

b. Contractor

c. Developer and/or Developer's engineer

3. Punch List

a. The Engineer will generate a draft punch list within five days of the walk-through and distribute to all participants as well as Township Operations Manager. Comments on the draft list shall be received by Engineer for five (5) subsequent days after which the punch list will be appropriately amended and issued to all participants. Punch list may be amended as deemed necessary by Engineer. If timing under the PA Municipal Planning Code is an issue, these proposed schedules will be subject to adjustment.

4. Other Requirements

a. Legal descriptions of all easements and land to be dedicated.

b. All other documents as noted in the Water/Sewer services agreement(s)

5. Dedication

a. The Engineer will make a recommendation on dedication to the Township Manager detailing the punch list in order to comply with Section 510 of the PA Municipal Planning Code. Once all items are completed satisfactorily, Engineer will so notify Township with copies to Developer, Contractor.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

(Not Used)

END OF SECTION

*TABLE 1 - ALLOWABLE LEAKAGE PER 1000 FT OF PIPELINE **

NOMINAL PIPE DIAMETER - IN.

Avg. Test Pressure Psi (bar)	3	4	6	8	10	12	14	16	18	20	24	30	36	42	48	54
450 (31)	0.24	0.32	0.48	0.64	0.80	0.96	1.12	1.28	1.44	1.59	1.91	2.39	2.87	3.35	3.82	4.30
400 (28)	0.23	0.30	0.45	0.60	0.75	0.90	1.05	1.20	1.35	1.50	1.80	2.25	2.71	3.16	3.61	4.06
350 (24)	0.21	0.28	0.42	0.56	0.70	0.85	0.99	1.13	1.27	1.42	1.69	2.11	2.53	2.95	3.37	3.79
300 (21)	0.20	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.17	1.30	1.56	1.95	2.34	2.73	3.12	3.51
275 (19)	0.19	0.25	0.38	0.50	0.62	0.75	0.87	1.00	1.12	1.25	1.50	1.87	2.24	2.12	2.99	3.36
250 (17)	0.18	0.24	0.36	0.48	0.60	0.71	0.83	0.95	1.07	1.19	1.43	1.78	2.14	2.50	2.85	3.21
225 (16)	0.17	0.23	0.34	0.45	0.57	0.68	0.79	0.90	1.02	1.13	1.35	1.69	2.03	2.37	2.71	3.02
200 (14)	0.16	0.22	0.32	0.43	0.53	0.64	0.74	0.85	0.96	1.06	1.28	1.60	1.91	2.23	2.55	2.87
175 (12)	0.15	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	0.99	1.19	1.49	1.79	2.09	2.39	2.68
150 (10)	0.14	0.19	0.28	0.37	0.46	0.55	0.65	0.74	0.83	0.92	1.06	1.38	1.66	1.93	2.21	2.49
125 (9)	0.13	0.17	0.25	0.34	0.42	0.51	0.59	0.67	0.76	0.84	1.01	1.26	1.51	1.77	2.02	2.27
100 (7)	0.12	0.15	0.23	0.30	0.38	0.45	0.52	0.60	0.68	0.75	0.90	1.13	1.35	1.58	1.80	2.03

- If the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size. When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gph/in. (0.0012 L/h/mm) of nominal valve size shall be allowed.
  When hydrants are in the test section, the test shall be made against closed hydrant valves.

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SECTION 01440

TESTING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. All fluid retaining structures/piping are required to be watertight and shall be tested by the Developer and witnessed by the Engineer. Structures/piping shall be tested as specified below.

B. All tests shall be conducted in a manner to minimize as much as possible any interference with the Developer's work or progress. Testing may not interfere with the use and operation of portions of adjacent water or wastewater systems already in use.

C. The Developer shall notify the Engineer when the work is ready for testing, and tests shall be made as soon thereafter as reasonably possible. Personnel for reading meters, gauges, or other measuring devices and all other labor, equipment, air, water, and materials, including meters, gauges, fuel, bulkheads, and accessory equipment, shall be furnished by the Developer.

1.02 FIELD TESTS – Gravity Sewers and Manholes

A. In order to keep leakage and infiltration in sewers and manholes within reasonable limits, it is necessary that special attention be given to specification requirements covering workmanship, materials and testing. Testing must occur prior to acceptance for use and again, prior to dedication, if final paving/restoration was not in place at time of testing for use. Specifications for this installation include the following provisions:

1. Infiltration and leakage through manhole walls and pipe joints shall not exceed 20 gallons per 24 hours per inch diameter per 1,000 feet of any type of pipe installed. Surface water leakage through manhole covers will be excluded from these limits but must be separately addressed. In testing for infiltration, sufficient weir measurements shall be made in manholes to furnish necessary information.

2. Where the Engineer determines that groundwater is not sufficiently high at the time of testing to determine the amount of infiltration or leakage, exfiltration tests shall be conducted in which a head of water at least three feet (3’) higher than the top of the pipe line in the highest section of the work being tested, is maintained during the period of the test.

   Allowable leakage per twenty-four hours per inch of diameter of pipe per 1,000 foot of sewer tested shall not exceed 20 gallons for any type of pipe installed.

   Water for such exfiltration tests shall be furnished by the Contractor and disposed of in a manner and location approved by Engineer.

3. Length and location of sections to be tested, duration of tests, and other requirements shall be determined by the Engineer.

4. Sewers and manholes shall not be tested until at least two weeks after installation. (Installation includes collector sewer and lateral sewer.) Final testing for dedication occurs only after final paving is in place.

5. All evident leaks shall be investigated and necessary repairs made, and leakage minimized regardless of total leakage as shown by test.

6. Pipes/appurtenances failing to pass tests shall be repaired and re-tested as necessary until they pass tests. Defective pipe and branch connections shall be removed and replaced. Manholes shall be repaired inside and/or outside, as required. Under no circumstances will pressure grouting be an approved method of repairing leaks in sewer pipe. Any defective pipe must be replaced with new material. The Contractor shall notify the Engineer 72 hours prior to testing and/or repairing so an observer can be present.

7. The Township requires TV inspection at the expense of the Developer of all sections of pipe. If an installed item is found to be defective, the Developer's Contractor shall replace that item at no cost to the Township or Engineer, even if the Township or Engineer had previously approved it. The repaired area must then be re-televised and pass to the satisfaction of Engineer..

B. In lieu of infiltration/exfiltration tests, air tests may be used if approved by the Engineer. This method will be used for sewers and laterals whose gradient is such that excessive pressures would develop from use of the water method. The air method may also be used for any test if so directed by the Engineer. These tests shall be conducted in accordance with the following:

1. Air compressors to be used for tests must be equipped to control air entry rate and prevent the pressure from exceeding 5 psig.

2. Tests will be performed on pipe with a wet inside condition.

3. All outlets from the section to be tested, fitted with airtight plugs and braced to withstand the applied pressure.

C. After the pipe has been wetted, air will be slowly admitted to the test section until a constant pressure of approximately 5.0 psig is reached and maintained for at least two minutes to allow for temperature equalization. During this time, all plugs shall be checked for tightness with soap solution. If leaks are found, pressure will be released and plugs tightened to stop the leakage. This procedure will be repeated until all plugged openings are found to be tight.

D. When air temperature has adjusted and pressure is constant at 5 psig, air supply will be disconnected, gauge observed and a stopwatch will be started, then stopped when pressure has reached 4.0 psig. The pipeline will be considered to have passed the air loss test successfully if the time shown on the stopwatch is not less than 10 minutes.

1.03 LABORATORY TESTS

A. The materials listed below shall require advance and periodic tests as indicated, and shall be sampled in accordance with the methods of ASTM and as required by the Engineer. The laboratory conducting the tests shall furnish both the Engineer and Developer with two copies of the reports showing results of such tests, and the report shall be considered as sufficient evidence of the acceptance or rejection of the quality of material tested. Specifications for, and methods of testing will be found under detailed specifications for the particular material involved. All samples shall be properly packed and clearly marked as to source and intended use.

Material	Test Frequency	Sample Size
Concrete (cast-in-place)	Advance, then each 50 cubic yards	4 cylinder per test 2 broken at 7 days and 2 at 28 days

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

3.01 MANHOLES

A. Exfiltration Method

1. The manhole to be tested shall have all sewer openings plugged and then be filled to the top with water. Although Developer may wish to perform preliminary or interim testing, the final test will occur only after final paving has been installed.
2. After the concrete has absorbed enough water for a stabilized condition, manhole shall be refilled and water level in the manhole shall be maintained for one hour without more than a 2” drop.
3. If manhole excavation is full of water, it shall be dewatered and kept dry during the test.

B. Vacuum Method

1. Each manhole may be tested immediately after assembly and prior to backfilling at option of the Developer. However, this test is not final
2. All lift holes shall be plugged with an approved non-shrink grout.
3. All pipes entering the manhole shall be plugged, taking care to securely brace the plug from being drawn into the manhole.
4. The test head shall be placed at the inside of the top of the cone section and the seal inflated in accordance with the manufacturers' recommendations.

5. A vacuum of 10 inches of mercury shall be drawn and the vacuum pump shut off. With the valves closed, the time shall be measured for the vacuum to drop to 9 inches. The manhole shall pass if the time is greater than 60 seconds for 48" diameter, 75 seconds for 60", and 90 seconds for 72" diameter manholes.

6. If the manhole fails the initial test, necessary repairs shall be made with a non-shrink grout while the vacuum is still being drawn. Retesting shall proceed until a satisfactory test is obtained.

3.02 PRESSURE PIPE – water and sewer

A. General

Where any section of a main is provided with concrete reaction backing (thrust block) for fittings or bases, the hydrostatic pressure test shall not be made until at least seven days after installation of the concrete reaction backing, unless otherwise approved by Engineer.

B. Test Restrictions

1. Test pressure shall not be less than 1.25 times the working pressure at the highest point along the test section.

2. Test pressure shall not exceed pipe or thrust-resistant design pressures.

3. The hydrostatic test shall be of at least 30-minute duration.

4. Test pressure shall not vary by more than +5 psi (35 mPa or 0.35 bar) for the duration of the test.

5. Valves shall not be operated in either direction at differential pressure exceeding the rated valve working pressure. Use of a test pressure greater than the rated valve pressure can result in trapped test pressure between the gates of a double-disc gate valve. For tests at these pressures, the test setup should include provision, independent of the valve, to reduce the line pressure to the rated valve pressure on completion of the test. The valve can then be opened enough to equalize the trapped pressure with the line pressure, or fully opened if desired.

C. Pressurization

1. After the pipe has been laid, all newly laid pipe or any valved section thereof shall be subjected to a hydrostatic pressure of at least 1.5 times the working pressure at the point of testing. Each valved section of pipe 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 the owner. Valves shall not be operated in either the opening or closing direction at differential pressures above the rated pressure. It is good

practice to allow the system to stabilize at the test pressure before conducting the leakage test.

D. Air Removal

1. Before applying the specified test pressure, air shall be expelled completely from the pipe, valves, and hydrants. If permanent air vents are not located at all high points, the contractor shall install corporation cocks at such points so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed and the test pressure applied. At the conclusion of the pressure test, the corporation cocks shall be removed and plugged or left in place at the discretion of the Township.

E. Examination

1. Any exposed pipe, fittings, valves, hydrants, and joints shall be examined carefully during the test. Any damaged or defective pipe, fittings, valves, hydrants, or joints that are discovered following the pressure test shall be repaired or replaced with sound material, and the test shall be repeated until it is satisfactory to the Township.

F. Backfilling

1. Contractor shall backfill all pipe and provide all reaction blocking before making hydrostatic leakage tests. It shall be the Contractor's responsibility to locate and repair any and all leaks that may develop. The Engineer may direct the Contractor to leave certain joints and connections uncovered until testing has been completed.

G. Leakage defined

1. Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe or any valved section thereof to maintain pressure within 5 psi (35 MPa or 0.35 bar) of the specified test pressure after the pipe has been filled with clean water and the air has been expelled. Leakage shall not be measured by a drop in pressure in a test section over a period of time.

H. Allowable Leakage

1. No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

$$L = \frac{SD\sqrt{P}}{266{,}400} \quad \text{(Eq. 1)}$$

Where:

L = Allowable leakage, in gallons per hour

S = length of pipe, in feet

D = nominal diameter of the pipe, in inches

P = average test pressure during the leakage test, in pounds per square inch (gauge)

This formula is based on an allowable leakage of 5.825 gpd/mi./in. of nominal diameter at a pressure of 150 psi.

2. Allowable leakage at various pressures is shown in the attached Table 1.

3. When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gph/in. (0.0012 L/h/mm) of nominal valve size shall be allowed.

4. When hydrants are in the test section, the test shall be made against closed hydrant valves.

I. Acceptance of Installation

1. Acceptance shall be determined based on allowable leakage. If any test of laid pipe discloses leakage greater than that as specified above the Developer shall, at his own expense, locate and make approved repairs as necessary until the leakage is within the specified allowance.

2. All visible leaks are to be repaired, regardless of the amount of leakage.

3.03 SEWER PIPE

A. Includes gravity sewer lines and other pipes intended to be watertight but not under pressure.

B. The Developer shall furnish all labor, tools, materials including water and equipment including mirrors, flashlights or other artificial lighting, weirs, pump, compressors, stopwatch, gauges, and meters, subject to the approval of the Engineer for testing in accordance with these specifications.

C. All branch fittings and ends of lateral stubs shall be securely plugged to withstand the internal test pressures. The section of line being tested shall also be securely plugged at each manhole. All stoppers shall be adequately braced when required.

D. Air shall be slowly supplied to the plugged pipeline until the internal air pressure reaches 5.0 pounds per square inch. At least two minutes shall be allowed for temperature stabilization before proceeding further. At the end of 2 minutes, bring pressure back to 5psi and start stop watch.

E. The rate of air loss shall then be determined by measuring the time interval required for the internal pressure to decrease by 1.0 pound per square inch to 4.0 psig.

F. The line shall be considered acceptable if the time, T, in minutes; required for the 1.0 psi pressure drop is not less than 10 minutes.

3.04 DEFLECTION TEST OF PVC PIPE

A. General

1. Deflection testing shall be performed on all portions of the PVC sewer system. This test shall be performed in sections between manholes, not less than 30 days after final grading has been placed.

B. Maximum Deflection

1. The maximum allowable deflection for all installed PVC sewer pipe shall not exceed 5% of the pipe's original internal diameter.

C. Testing Apparatus

1. Deflection testing shall be performed with a "go, no-go" mandrel, which shall have a diameter not less than 95% of the base inside diameter or average inside diameter of the pipe as specified in the ASTM Specification. The pipe shall be measured in compliance with ASTM D 2122 Standard Test Method of Determining Dimensions of Thermoplastic Pipe and Fittings. The test shall be performed without mechanical pulling devices.

D. Deflection Testing Procedure

1. Completely flush the line making sure the pipe is clean of any mud or debris that would hinder the passage of the mandrel.

2. During the final flushing of the line, attach a floating block or ball to the end of the mandrel pull rope and float the rope through the line.

3. After the rope is threaded through the line, connect the pull rope to the mandrel and place the mandrel in the entrance of the pipe.

4. Connect a retrieval rope to the back of the mandrel to pull it back if necessary.

5. Remove all the slack in the pull rope and place a tape marker on the rope at the ends of the pipe.

6. Draw mandrel through the sewer line. If any irregularities or obstructions are encountered in the line, those areas shall be replaced or corrective action taken to correct the condition to the satisfaction of the Township.

7. If a section of excessive deflection is found, that section of the pipe shall be replaced to the satisfaction of the Township.

END OF SECTION

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SECTION 01441

LAGOON TESTING

PART 1 GENERAL

1.01 PURPOSE AND SCOPE

A. Tests based on these guidelines can only indicate whether the permeability on a new lagoon is within the PADEP guidelines of permeability of 1 x 10^{-7} cm/sec or less.

1.02 GENERAL APPROACH

A. The general objective of a leak test is to estimate the average rate of seepage through the bottom of the lagoon. Each lagoon cell is isolated and tested separately, which better pinpoints the location of any major leaks. The rate of seepage is expressed in inches per day or centimeters per second.

B. Leak testing is best conducted during summer, when rainfall is minimal and the ground is dry enough to exclude significant runoff. Tests conducted at other times may have more variables and may underreport seepage due to runoff effects.

C. To obtain reasonable precision, each cell of a lagoon should be isolated and tested over a period of 30 to 90 days. Cell depth and pan evaporation measurements should be taken daily. If the lagoon cell cannot be isolated, then daily influent/effluent flows must also be measured. Daily measurements are preferred over weekly to improve precision and to minimize random measurement errors.

D. Lagoon liquid depth should suit the purpose of the test. To determine average seepage rates, lagoons should be at 1 foot above the normal high water elevation.

E. In priority areas, any rate of seepage greater than zero may warrant direct sampling and monitoring of the groundwater. Unaccounted-for water loss (assumed to be seepage) of 0.02" per day or less is normal. Seepage exceeding 0.02" per day indicates a possible seal failure, or absence of adequate initial seal.

PART 2 PRODUCTS

N/A

PART 3 EXECUTION

3.01 EQUIPMENT REQUIREMENTS

A. Each cell of a lagoon needs to be equipped with a staff gauge for level measurements. Stilling wells to dampen wave action are recommended, and will

allow a staff gauge to be read to 1/8" - 1/16". Precipitation can be measured to about 1/100" with a good rain gauge. Evaporation can be measured to roughly 1/1000" with a hook gauge. Daily staff gauge measurements should be confirmed with weekly laser transit elevation measurements using the stipulated project benchmark.

B. The following specifications for rainfall and evaporation equipment are based on Weathertronics equipment manufactured by Qualimetrics, Inc. of Sacramento, and available in Oregon through International Reforestation Supply, Eugene (345-0597). Equivalent equipment is acceptable.

1. Rain Gauge. Qualimetrics Model 6330. This is a plastic gauge with 11" capacity and 0.01" graduations, designed for post mounting.

2. Evaporation Pan. Qualimetrics Model 6821. This is a standard US Weather Bureau steel pan, 47.5" diameter by 10" deep.

3. Hook Gauge. Qualimetrics Model 6831. This is a brass gauge with 0.02" graduations.

C. To obtain accurate measurements, the equipment needs to be set up level and plumb in an unsheltered area near the lagoon.

D. The above list is a minimum. Various equipment needed to attain higher levels of accuracy is not listed. For example:

1. Recording anemometer

2. Max/min thermometers for air, for the evaporation pan, and for the lagoon surface

3. Upwind and downwind evaporation pans

4. Barometric pressure

If such equipment is available, its use will add precision and accuracy to the results.

3.02 MEASUREMENTS AND CALCULATIONS

A. Measurements should be made on a schedule, at the same time each day, so that each set of data represents the duration of exactly one day. All measurements should be tabulated to aid calculation and reported using the attached form or a similar format.

B. Computations should be converted to compatible units of either depth or gallons. All sources impacting lagoon volume should be monitored or calculated daily. Sources include influent flow, precipitation, evaporation from the surface, mechanical evaporation and allowable leakage.

C. Evaporation will vary with wind and temperature. It should be measured daily, and the pan should be kept well filled.

D. Lagoon evaporation rates are invariably less than pan evaporation rates. Pan correction factors generally vary from 0.7 to 0.9. The larger the lagoon, the more its evaporation rate lags behind pan evaporation, so the smaller the numerical value of the pan correction factor.

E. In hot and windy summer weather, evaporation can be substantial. An erroneous pan correction factor can inject significant error. The result of computing seepage rates without any correction for pan evaporation is to over calculate the evaporation rate. The effect of this error would be to underreport the seepage rate.

3.03 REPORT FORMAT

A. Leakage reports should be short and to the point. The main conclusion is to estimate the seepage rate from each lagoon cell, and from the lagoon as a whole. The methodologies and equipment need to be described briefly but thoroughly. A copy of all field measurements and calculations should be tabulated and attached as supporting documentation.

B. An excel spreadsheet, approved by the Township Water and Wastewater Operations Manager and Engineer, shall be used to summarize the monitoring program and a related line graph used to demonstrate that each lagoon cell has passed (or failed) the seepage test. When the x-axis is time and the y-axis is net loss (gain) in gallons per square feet per day, the data points should be on both sides of net zero if losses or gains are more than 0.02 inches per day. (refer to attached examples).

END OF SECTION

LAGOON LEAK TEST

LOCATION _____

CELL NO._____ WATER SURFACE AREA_____

CELL WATER DEPTH @ TEST START_____ @ TEST END_____

Date	**Influent (gal/Day)**	**+Precip. (gal/Day)**	**-Evap. (gal/Day)**	**-Effluent. (gal/Day)**	**= Net. Seepage(gal/Day)**

SECTION 01500

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Temporary Utilities: Electricity, lighting, heat, telephone service, water, and sanitary facilities.

B. Temporary Controls: Barriers, enclosures and fencing, protection of the Work, and water control.

C. Construction Facilities: Access roads, parking, project signage, field offices, and progress cleaning.

1.02 TEMPORARY ELECTRICITY

A. Provide and pay for power service required from Utility source.

B. Provide temporary electric feeder and electrical service.

C. Provide separate metering for cost of energy used.

1.03 TEMPORARY LIGHTING

A. Provide and maintain lighting for construction operations.

1.04 TEMPORARY HEAT

A. Provide heat devices and heat as required to maintain specified conditions for construction operations.

1.05 TELEPHONE SERVICE

A. Provide, maintain and pay for telephone service to field office.

1.06 TEMPORARY WATER SERVICE

A. Provide, maintain and pay for suitable quality water service required for construction operations.

1.07 TEMPORARY SANITARY FACILITIES

A. Provide and maintain required facilities and enclosures.

1.08 BARRIERS AND FENCING

A. Provide barriers or fencing to protect existing facilities and adjacent properties from damage from construction operations and demolition.

B. Provide protection for plant life designated to remain. Replace damaged plant life.

C. Protect non-owned vehicular traffic, stored materials, site and structures from damage.

1.09 WATER CONTROL

A. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.

B. Protect site from puddling or running water. Provide water barriers, as required, to protect site from soil erosion.

1.10 PROTECTION OF INSTALLED WORK

A. Protect installed Work and provide special protection where specified in individual specification Sections.

B. Provide temporary and removable protection for installed Products. Control activity in immediate work area to minimize damage.

C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

D. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

E. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

F. Prohibit traffic from landscaped areas.

1.11 ACCESS ROADS

A. Construct and maintain temporary roads accessing public thoroughfares to serve construction area.

B. Extend and relocate as Work progress requires. Provide detours necessary for unimpeded traffic flow.

C. Provide and maintain access to fire hydrants, free of obstructions.

D. Provide means of removing mud from vehicle wheels before entering streets.

E. Contractor shall comply with the "Manual on Uniform Traffic Control Devices" by the National Advisory Committee on Uniform Traffic Control Devices and PADOT Publication 203 "Work zone Traffic Control" by the Pennsylvania Department of Transportation.

1.12 PARKING

A. Arrange for temporary parking areas to accommodate construction personnel.

B. When site space is not adequate, provide additional off-site parking.

1.13 PROGRESS CLEANING

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition. Brush clean or wash roadway near construction entrance(s) regularly.

B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.

C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

D. Remove waste materials, debris, and rubbish from site and dispose off-site.

E. Maintain dust free all construction areas and adjacent sites.

1.15 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary above grade or buried utilities, equipment, facilities, materials, prior to final 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.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

(Not Used)

END OF SECTION

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SECTION 01600

MATERIAL AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Products.

B. Transportation and handling.

C. Storage and protection.

D. Product options.

E. Substitutions.

1.02 PRODUCTS

A. Products: Means new material, plant materials, components, equipment, fixtures, and systems forming the Work. Does not include machinery and equipment used for preparation, fabrication, conveying and erection of the Work. Products may also include existing materials or components required for reuse.

B. Do not use materials and equipment removed from existing premises, except as specifically permitted by the Contract Documents.

1.03 TRANSPORTATION AND HANDLING

A. Transport and handle products in accordance with supplier or manufacturer's instructions.

B. Promptly inspect shipments to assure that products comply with requirements, quantities are correct, and products are undamaged.

C. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

1.04 STORAGE AND PROTECTION

A. Store and protect products in accordance with supplier's, manufacturer's and/or Township's instructions, with seals and labels intact and legible. Store sensitive products in weather-tight, climate controlled enclosures. Store plant materials to prevent excessive drying and exposure to harsh environmental conditions.

B. Provide off-site storage and protection when site does not permit on-site storage or protection.

C. Cover products subject to deterioration with appropriate covering to prevent damage.

D. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

E. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage. Store plant materials to prevent damage to roots, limbs or foliage.

F. Arrange storage of products to permit access for inspection. Periodically inspect to assure products are undamaged and are maintained under specified conditions.

1.05 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Any product meeting those standards or description.

B. Products Specified by Naming One or More Manufacturers: Products of manufacturers named and meeting specifications. No options or substitutions will be allowed.

C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

1.06 SUBSTITUTIONS

A. Substitutions may be considered when a product becomes unavailable through no fault of the Developer.

B. Document each request with complete data substantiating compliance of proposed Substitution with the Approved Plans.

C. A request constitutes a representation that the Developer:

1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.

2. Will provide the same warranty for the Substitution as for the specified product.

3. Will coordinate installation and make changes to other Work, which may be required for the Work to be complete with no additional cost to Owner.

4. Waives claims for additional costs or time extension, which may subsequently become apparent.

E. Substitutions will not be considered when they are indicated or implied on product data submittals, without separate written request, or when acceptance will require revision to the Approved Plans.

F. Substitution Submittal Procedure (all to Engineer):

1. Submit three copies of request for Substitution for consideration. Limit each request to one proposed Substitution.

2. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence.

3. Engineer will notify Developer, in writing, of decision to accept or reject the request.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

(Not used)

END OF SECTION

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SECTION 01700

PROJECT CLOSEOUT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Closeout procedures.

B. Final cleaning.

C. Adjusting.

D. Project record documents.

E. Operation and maintenance data.

F. Warranties.

G. Spare parts and maintenance materials.

1.02 CLOSEOUT PROCEDURES

A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Engineer's inspection.

B. Provide submittals to Engineer or Owner that are required by governing or other authorities.

C. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due. Include all specified releases, guarantees, waivers and other documents.

1.03 FINAL CLEANING

A. Execute final cleaning prior to final inspection.

B. Clean interior and exterior glass and surfaces; remove temporary labels stains and foreign objects.

C. Clean equipment and fixtures to a sanitary condition.

D. Clean site; sweep paved areas, rake clean landscaped surfaces.

E. Remove waste and surplus materials, rubbish, and construction facilities from the site.

1.04 ADJUSTING

A. Adjust operating products and equipment to ensure smooth and unhindered operation.

1.05 PROJECT RECORD DOCUMENTS

A. Maintain on site, one set of the following record documents; record actual revisions to the Work:

1. Contract Drawings.

2. Specifications.

3. Change Orders and other modifications to the Contract.

4. Reviewed shop drawings product data, and samples.

5. As-builts

B. Store Record Documents separate from documents used for construction.

C. Record information concurrent with construction progress.

D. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:

1. Manufacturer's name and product model and number or description.

2. Product substitutions or alternates utilized.

3. Changes made by Addenda and modifications.

E. As-Builts - Unless otherwise specified, the as-builts shall be maintained in accordance with Section 01725.

F. Submit documents to Engineer with claim for final Application for Payment.

1.06 OPERATION AND MAINTENANCE DATA

A. Unless otherwise specified, the Operation and Maintenance Data shall be maintained in accordance with Section 01730.

B. Submit final volumes revised, within ten days after final inspection.

1.07 WARRANTIES

A. Provide duplicate notarized copies.

B. Execute and assemble documents from Subcontractors, suppliers, and manufacturers.

C. Assemble in binder with durable cover.

D. Submit prior to final Application for Payment.

E. Provide starting and ending dates of warranty period.

1.08 SPARE PARTS AND MAINTENANCE MATERIALS

A. Provide products, spare parts, maintenance and extra materials in quantities specified in individual specification sections.

B. Deliver and place in location as directed; obtain receipt prior to final payment.

PART 2 PRODUCTS

(Not used)

PART 3 EXECUTION

(Not used)

END OF SECTION

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SECTION 01725

AS-BUILT DOCUMENTS

PART 1 GENERAL

1.01 INTRODUCTION

A. As-Built drawings are prepared to show changes made to the project during construction, and are the official records of the project at the time of construction completion. All additions, deletions and other changes made during construction are indicated by modifying the original contract drawings. Accurate as-built drawings are very important for operation and maintenance, and when modifications to a facility are made in the future, particularly for plumbing and electrical systems, which are hidden from view.

B. Instructions for preparing high-quality As-Built drawings are contained in the following paragraphs.

C. Prior to each request for partial progress payment, Engineer will review the working as-built drawings with the Contractor. Progress payments may be reduced by as much as 15 percent if working as-builts drawings are not current.

1.02 MARKED-UP PRINTS: (Working As-Builts)

A. Whenever changes, additions or deletions from the original design are made during construction, they will immediately be noted on each of the as-built print set, as appropriate. No other marks, doodles, notes, or annotations shall be put on these sets of as-built prints. All changes from the contract plans, which are made in the work, or additional information which might be uncovered in the course of construction will be accurately and neatly recorded as they occur by means of details and notes. All changes and/or required additions to the paper prints will be clearly identified in color contrasting to blue or black, preferably red. The as-built print sets will be annotated in as much detail as necessary to clarify exactly what construction changes were performed.

B. Areas of Concern: The following are some of the general items that need some special checking to ensure that the marked-up prints are complete and accurate:

1. Location, size and type of existing and new utility lines, especially underground lines within the construction area. Measurements will be shown for all change of direction points and all surface or underground components such as valves, manholes, drop inlets, clean outs, meters, etc. The descriptions of exterior utilities shall include the actual quantity, size, and material of the utility lines.

2. Layout and schematic drawings of electrical circuits and piping.

3. Correct dimensions and details transferred from shop drawings.

4. Verification of alignment, cross-section, and layout of the earthwork.

5. Actual location of anchors, construction and control joints, etc., in concrete.

6. Changes in location of equipment and architectural features.

7. Cross out such words and phrases as “or equal, and list specifically the items of material provided.

8. Unusual or uncharted obstructions that are encountered in the contract work area during construction.

9. Location, extent, thickness, and size of stone protection particularly where it will be normally submerged by water.

C. Mark-up Guidelines: The following information is provided to the Contractor as suggestion to improve the quality of the marked-up prints and thereby facilitate preparation of as-built drawings after construction. The most important guideline is that the marked-up changes on the prints shall be complete and understandable. The draftsperson that later will make the corrections on the original tracings likely will not have worked on the original design and probably will not have been on-site during the construction of the project. Visits to the site by the draftsperson, or visits to the draftsperson by the construction superintendent, can be minimized by providing complete and understandable marked-up prints.

1. Use written explanations on As-Built drawings more frequently to describe changes - do not rely totally on graphic means to convey the revision.

2. Legibility of lettering and digit values shall be precise and clear when marking prints, and clarify ambiguities concerning the nature and application of change involved.

3. Wherever a revision is made, make changes to affect related section views, details, legend, profiles, plans and elevation views, schedules, notes and call-out designations, and mark accordingly to avoid conflicting data on all other sheets.

4. When changes are made, cross out all features, data and captions that relate to that revision.

5. When changes are required on small-scale drawings and in restricted areas, suggest large-scale inserts be drawn or sketched, with leaders to the location where applicable.

6. Be sure descriptive markings in red conform to legend symbols shown, or provide a legend if other colors are used.

7. Be sure to add and denote in legend, any additional equipment or material facilities, service lines, etc., incorporated under As-Built Revision if not already shown in legend.

8. When attached prints (or sketches) are provided with marked-up print, indicate whether a) entire drawing shall be added to contract drawings or b) whether the contract drawings shall be changed to agree, or c) for reference only to further details not required for initial design.

9. Make the comments on the drawing complete without reference to letters, memo's, or materials that are not also a part of the As-Builts.

10. Annotating the drawing, "Per Change Order #2," means nothing when the actual change order states, "added an additional 12 duplex" outlets or similar statements. The Operator must know what was changed, how it was changed, where the items(s) were relocated to and how the affected connections were altered. Change Orders usually do not provide information as to how the facility was changed, only what was changed.

11. The markups shall be accomplished on blue or black line copies of the most current originals. Frequently the packages received consist of blue or black lines, which do not include one or more revisions made on the originals through the amendment process prior to contract award. This raises the question, which drawing was used for construction? This is especially true if major revision to the facility have been made on the originals.

12. Shop drawings are to be incorporated into the As-Built drawings. They will be provided in electronic CAD file format (or 3 mil double matte polyester or photo mylar for non-electronic contracts). Hand drawn or plotted paper shop drawings will not be accepted as submittals.

    The quality of shop drawings which normally accompany "As-Builts" packages are not usable as original drawings for several reasons.

    a) The "shop drawings" are not reproducible in blue line form.

    b) The drawings are not of an adequate scale or are drawn to no scale and are not transferable to the Engineers drawings due to lack of information.

    Sheets shall be drawn at the same scale as similar drawings in the set (example: Fire alarm systems shall be drawn to the same scale as the plumbing or electrical drawings). The drawing shall meet the same

standards required for the rest of the drawings set. Sheet number, detail number, etc shall tie details and sketches to existing drawings.

1.03 AS-BUILT DRAWINGS: (Final As-Builts)

A. The Contractor will transfer the changes from the marked-up prints to the original electronic CAD files (or original mylar drawings).

B. At SUBSTANTIAL COMPLETION the Engineer will provide the Contractor the electronic CADD drawing (or original mylar drawings) for his use in preparing the as-builts. The electronic format will be in AUTOCADD 2000 format.

1.04 DRAFTING STANDARDS:

A. The Owner requires that standard professional engineering drafting practices be utilized in correcting the original contract mylar or electronic CAD drawings to show as-built conditions. In general, the letter styles, line thickness, and scale will be the same as the original drawings. Corrections will be made in black ink, unless the originals are prepared in pencil, in which case the corrections also will be in pencil. When shop drawings or other sheets are added, they will be drawn in electronic CAD or on 3 mil double matte mylar or reproduced on photo mylar and will be the same size and layout as the original drawings. The following specific requirements apply to the preparation of as-built drawings:

B. Revisions Block entries: Those sheets which have changes shown on them will have REVISED AS-BUILT entered in the first available space. This will be revision one and a number 1 will be entered in the triangle at the beginning of that line. In the event the sheet has already been revised and a number and revision appear in the revision lines the next sequential number will be used. Normally the first entry is made in the first line. The completed originals drawings (or CAD files) will be reviewed for accuracy and initialed by the Contractor.

C. Marking Revisions: All changes will be indicated by placing an equilateral triangle near the area revised. Where several items in a table or detail are changed (or completely redrawn), one triangle may be placed near the table or detail title. This same method may be used for general revisions to floor plans and system plans (plumbing, electrical, a/c, heating); when a major portion of the drawing is changed, the triangle may be placed near the diagram, detail, section or plans title. When only a few items are revised, added or deleted a triangle will be placed near each item. The triangles will contain the same number as the As-Built revision on that sheet.

D. Revision Procedure:

1. Deletion - when the marked-up print indicates an item was not installed, the item will be crossed out on the drawing along with any associated devices, connecting lines, ducts, pipes etc., including notes and dimensions. When a detail is indicated as not being used, the detail

may be boxed and NOT USED lettered across the detail. A box will be drawn on the (reverse side for manual drawings) sheet with an X. The words NOT USED will be in heavy block lettering. A triangle and revision number will be placed inside the box where notes are indicated as not being used.

2. Notes - a line may be drawn thru the note or line item in a table in lieu of erasing the line item or note. The line will be drawn on the reverse side for manual drawings. A triangle and number will be placed near the deleted item.

3. Additions - When the marked-up print indicates items have been added, the new or additional item or items will be drawn on the original and associated connections made if the print indicates such connections. A triangle and number will be placed near the new item. All lettering will conform to the existing lettering on each sheet.

4. Relocations: When the marked-up print indicates an item has been moved and the new location is shown or indicated, the item will be drawn in the new location and erased from the old location. All connections will be transferred if applicable, such as wiring, piping, and ducts. Revision triangles with appropriate number will be shown at the new and old location.

5. Drawing continuity: The applicable drawings shall be marked-up when a change was made, although this will not always be the case. Final responsibility for drawing continuity is with the person doing the As Built. When one floor plan indicates a wall, room, doors etc., has been changed, the same change shall be made on all other applicable drawings. When the change is applicable to only one discipline such as electrical and does not directly affect other discipline sheets, a note may be added to other discipline sheets such as

   "See sheet _____ for As-Built Conditions."

6. Shop drawings: When shop drawings are added to the original contract drawing set they need to be appropriately labeled with the Sacramento District file number, and discipline and sequence sheet number. The Index of Drawings will also need to be revised to show the additional sheet (s) with the appropriate sheet title. In the case where the shop drawing is smaller than the standard sheet size (i.e. 8.5"x11" or 11"x17" etc.) the sheets will be cut into a standard sheet size border sheet and appropriately labeled.

7. CAD Standards: All as-built "triangled" changes (refer to MARKED REVISIONS paragraph above) shall be on a separate single layer named ASBUILT, using a single color with an associated medium pen width.

1.05 TRANSMITTAL PROCEDURE

A. Unless otherwise specified, the as-builts shall be transmitted in accordance with Section 01300.

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

Not used

END OF SECTION

SECTION 01730

OPERATING AND MAINTENANCE INFORMATION

PART 1 GENERAL

1.01 SCOPE

A. Operation and maintenance (O&M) instructions shall be provided in accordance with this section and as required in the technical sections of this project manual. O&M information shall be provided for each maintainable piece of equipment, equipment assembly or subassembly, and material provided or modified under this contract.

B. O&M instructions must be submitted and accepted by Engineer and Township before on-site training may start.

1.02 OPERATION AND MAINTENANCE DATA

A. Prepare binder covers with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS", title of project.

B. Internally subdivide the binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.

C. Contents: Prepare a Table of Contents.

D. Part 1: Directory, listing names, addresses, and telephone numbers of Engineer, Contractor, Subcontractors, and suppliers.

E. Part 2: Operation and maintenance instructions. Provide the information described in paragraph 1.03 for all equipment and materials utilized in the project. Identify names, addresses, and telephone numbers of Subcontractors and suppliers.

F. Part 3: Appendices

1.03 TYPES OF INFORMATION REQUIRED

A. GENERAL:

O&M information shall contain the names, addresses, and telephone numbers of the manufacturer, the nearest representative of the manufacturer, and the nearest supplier of the manufacturer's equipment and parts. In addition, one or more of the following items of information shall be provided as applicable.

B. OPERATING INSTRUCTIONS:

Specific instructions, procedures, and illustrations shall be provided for the following phases of operations:

1. SAFETY PRECAUTIONS: List personnel hazards for equipment and list safety precautions for all operating conditions.

2. OPERATOR PRESTART: Provide requirements to set up and prepare each system for use.

3. STARTUP, SHUTDOWN, AND POSTSHUTDOWN PROCEDURES: Provide a control sequence for each of these operations.

4. NORMAL OPERATIONS: Provide control diagrams with data to explain operation and control of systems and specific equipment.

5. EMERGENCY OPERATIONS: Provide emergency procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage to systems and equipment. Include emergency shutdown instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance on emergency operations of all utility systems including valve locations and portions of systems controlled.

6. OPERATOR SERVICE REQUIREMENTS: Provide instructions for services to be performed by the operator such as lubrication, adjustments, and inspection.

7. ENVIRONMENTAL CONDITIONS: Provide a list of environmental conditions (temperature, humidity, and other relevant data) which are best suited for each product or piece of equipment and describe conditions under which equipment should not be allowed to run.

C. PREVENTIVE MAINTENANCE:

The following information shall be provided for preventive and scheduled maintenance to minimize corrective maintenance and repair:

1. LUBRICATION DATA: Provide lubrication data, other than instructions for lubrication in accordance with paragraph 2.0 B.6.

    a. A table showing recommended lubricants for specific temperature ranges and applications. Table should have cross-references to at least three manufacturers offering equivalent lubricants and their names.

    b. Charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities.

    c. A lubrication schedule showing service interval frequency.

2. PREVENTIVE MAINTENANCE PLAN AND SCHEDULE: Provide manufacturer's schedule for routine preventive maintenance, inspections, tests, and adjustments required to ensure proper and economical operation and to minimize corrective maintenance and repair. Provide manufacturer's projection of preventive maintenance man-hours on a daily, weekly, monthly, and annual basis including craft requirements by type of craft.

D. CORRECTIVE MAINTENANCE:

Manufacturer's recommendations shall be provided on procedures and instructions for correcting problems and making repairs.

1. TROUBLESHOOTING GUIDES AND DIAGNOSTIC TECHNIQUES: Provide step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.

2. WIRING DIAGRAMS AND CONTROL DIAGRAMS: Wiring diagrams and control diagrams shall be point-to-point drawings of wiring and control circuits including factory-field interfaces. Provide a complete and accurate depiction of the actual job-specific wiring and control work. On diagrams, number electrical and electronic wiring and pneumatic control tubing and the terminals for each type identically to actual installation numbering.

3. MAINTENANCE AND REPAIR PROCEDURES: Provide instructions and list tools required to restore product or equipment to proper condition or operating standards.

4. REMOVAL AND REPLACEMENT INSTRUCTIONS: Provide step-by-step procedures and list required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerances, dimensions, settings, and adjustments required. Instructions shall include a combination of test and illustrations.

5. SPARE PARTS AND SUPPLY LISTS: Provide lists of spare parts and supplies required for maintenance and repair to ensure continued service or operation without unreasonable delays. Special consideration is required for facilities at remote locations. List spare parts and supplies that have a long lead time to obtain.

6. CORRECTIVE MAINTENANCE MANHOURS: Provide manufacturer's projection of corrective maintenance man-hours including craft requirements by type of craft. Corrective maintenance that requires

participation of the equipment manufacturer shall be identified and tabulated separately.

E. APPENDICES:

The following information shall be provided; include information not specified in the preceding paragraphs but pertinent to the maintenance or operation of the product or equipment.

1. PARTS IDENTIFICATION: Provide identification and coverage for all parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Include special hardware requirements, such as requirement to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustrations and separate listing shall show the index, reference, or key number, which will cross-reference the illustrated part to the listed part. Parts shown in the listings shall be grouped by components, assemblies, and subassemblies.

2. WARRANTY INFORMATION: List and explain the various warranties and include the servicing and technical precautions prescribed by the manufacturers or contract documents to keep warranties in force.

3. PERSONNEL TRAINING REQUIREMENTS: Provide information available from the manufacturers to use in training designated personnel to operate and maintain the equipment and systems properly.

4. TESTING EQUIPMENT AND SPECIAL TOOL INFORMATION: Provide information on test equipment required to perform specified tests and on special tools needed for the operation, maintenance, and repair of components.

1.04 TRANSMITTAL PROCEDURE

A. Unless otherwise specified, O&M manuals, information, and data shall be transmitted in accordance with Section 01300.

B. Five copies of the specified O&M information shall be provided. For ease of identification, each manufacturer's brochure and manual shall be appropriately labeled with the equipment name and equipment number as it appears in the project manual. The information shall be organized in three-ring binders in numerical order by the equipment numbers assigned in the project manual. The binders shall be provided with a table of contents and tab sheets to permit easy location of desired information.

C. If manufacturers' standard brochures and manuals are used to describe O&M procedures, such brochures and manuals shall be modified to reflect only the model or series of equipment used on this project. Extraneous material shall be crossed out neatly or otherwise annotated or eliminated.

1.05 PAYMENT

A. Acceptable O&M information for the project must be delivered to the Engineer prior to the project being 65 percent complete. Progress payments for work in excess of 65 percent completion will not be made until the specified acceptable O&M information has been delivered to the Engineer.

1.06 FIELD CHANGES

A. Following the acceptable installation and operation of an equipment item, the item's instructions and procedures shall be modified and supplemented by the Contractor to reflect any field changes or information requiring field data.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

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DIVISION 2

SITE WORK

Castle Valley Consultants, Inc.
Engineers • Planners • Design Professionals
10 Beulah Road, New Britain, Pa. 18901
Phone (215) 348-8257 Fax (215) 348-8267
Web: www.casval.com

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SECTION 02058

TELEVISION INSPECTION AND SEWER LINE CLEANING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Television inspection and recording of sanitary sewer lines.

B. High pressure cleaning of sanitary sewer lines.

C. Work under this item shall consist of furnishing all equipment, labor, and material necessary for investigation of pipelines by use of Closed-Circuit Color Television to determine condition of lines or any other data, such as infiltration, etc., at locations ordered by the Engineer and in accordance with these specifications.

1.02 SUBMITTALS

A. Provide two copies of the completed videotape (VHS format).

1. Beginning of each video sequence between manhole runs shall include an audio and video overlay with the following information:

a. Date

b. Location (local town, development, street address, etc.)

c. Sewer line run (i.e., Manhole X to Manhole Y) with direction of run.

d. Pipe material and size

e. Comment section.

2. Audio and video overlay information to be included on videotape while in operation shall include the following information:

a. Continuous video stationing information shall be in the standard format (i.e., 1 + 23).

b. Intermittent audio information with quadrant location shall include, but not limited to, all laterals, clean-outs, pipe deflection, pipe defects, and infiltration.

3. Video image shall be free of any obstructions, including water vapor, allowing a clear 360° image of pipe interior.

B. Record Keeping

1. *Television Inspection Logs*: Printed location records shall be kept by the Contractor and will clearly show the location in relation to an adjacent manhole

of each infiltration point observed during inspection. In addition, other points of significance such as locations of building sewers, unusual conditions, roots, storm sewer connections, broken pipe, presence of scale and corrosion, and other discernible features will be recorded and a copy of such records will be supplied to the Owner.

2. *Photographs*: Instant developing, 35 mm, or other standard-size photographs of the television problems shall be taken by the Contractor upon request of the Owner's Representative, as long as such photographing does not interfere with the Contractor's operations.

3. *Videotape Recordings*: The purpose of tape recording shall be to supply a visual and audio record of problem areas of the lines that may be replayed. Videotape recording playback shall be at the same speed that it was recorded. Slow motion or stop-motion playback features may be supplied at the option of the Contractor. The Contractor shall have all videotapes and necessary playback equipment readily accessible for review by the owner during the project, after which time the tapes shall become the property of the Owner.

1.03 REGULATORY REQUIREMENTS

A. Conform to applicable local, State and Federal regulations and codes for safety of workers; noise, odor and runoff control; transport and disposal of debris.

B. Obtain all required permits and notices from authorities for all portions of the work.

C. Notify affected utility companies before starting work and comply with their requirements.

D. Do not close or obstruct roadways without permits.

1.04 PROTECTION

A. Closing or obstruction of roadways, sidewalks, and driveways adjacent to the Work by the placement or storage of materials will not be permitted, and all operations shall be conducted with a minimum interference to traffic on these ways.

B. Repair damage to any property belonging to the Owner or adjacent landowners caused by the Work.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

3.01 PREPARATION

A. Protect existing landscaped areas, appurtenances and other features.

3.02 CLEANING

A. Provide for collection of debris from cleaning operation.

1. All downstream manhole channels shall be screened to capture all flushed debris.

2. Where Sanitary sewer is not yet connected to an existing collection system, Contractor shall dispose of water at his own expense and not into an existing sanitary sewer system or pump station.

B. High pressure clean from upstream manhole to downstream manhole, collecting debris at each downstream manhole.

3.03 DISPOSAL

A. The Developer is responsible for disposal of all debris.

B. Remove collected debris as soon as possible and dispose in a manner approved by the PA Department of Environmental Protection.

3.04 VIDEO TAPING

A. After cleaning operation, video inspection shall be conducted. Inspection shall be by closed-circuit television and shall be performed in one section at a time. Pipelines shall be clean and dry throughout prior to television investigation.

B. The color television camera used for the inspection shall be specifically designed and constructed for such inspection. Lighting for the camera shall be suitable to allow a clear picture of the entire periphery of the pipe. The camera shall be operative in 100% humidity conditions. The camera, television monitor, and other components of the video system shall be capable of producing picture quality to the satisfaction of the Owner's Representative: and if unsatisfactory, equipment shall be removed and no payment will be made for an unsatisfactory inspection.

C. The camera shall be moved through the line in either direction at a moderate rate, stopping when necessary to permit proper documentation of the sewer's condition. In no case will the television camera be pulled at a speed greater than 30 feet per minute. Manual winches, power winches, TV cable, and powered rewinds or other device that do not obstruct the camera view or interfere with proper documentation of the sewer conditions shall be used to move the camera through the sewer line. If, during the inspection operation, the television camera will not pass through the entire manhole section, the Contractor shall set up his equipment so that the inspection can be performed from the opposite manhole. If, again, the camera fails to pass through the entire manhole section, the obstruction must be removed or problem addressed so that the entire section may be videoed.

D. When manually operated winches are used to pull the television camera through the line, telephones or other suitable means of communication shall be setup between the two manholes of the section being inspected to insure good communication between members of the crew.

E. Measurement for location of defects shall be above ground by means of a meter device. Marking on the cable, or the like, which would require interpolation for depth of manhole, will not be allowed. Accuracy of the distance meter shall be checked by use of a walking meter, roll-a-tape, or other suitable device, and the accuracy shall be satisfactory to the Engineer and/or Owner's Representative.

F. Unacceptable conditions are conditions that adversely affect the ability of the system to function as designed or to be properly maintained and may include, but are not limited to, the following:

1. Protruding taps
2. Cracked or faulty pipe
3. Misaligned or deformed pipe
4. Debris in line
5. Infiltration / exfiltration
6. Excessive gaps at joints

G. The percent of standing water at a sag in a sewer main will determine if the pipe is acceptable or not.

1. Sags that make up 5% or less of the pipe area are approved.
2. Sags that are between 5-10% of the pipe area are at the discretion of the Township to accept or reject.
3. Sags that are more than 10% of the pipe area are unacceptable and should be rejected unless justified by the Engineer of Record to the Township. Acceptance is not final until agreed to by the Township. A letter of credit or a performance bond will be required for sags such as this; warranty extensions without this protection are not acceptable.

END OF SECTION

SECTION 02110

SITE CLEARING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Remove surface debris.

B. Remove paving, curbs, and/or surface rock as required to complete the Work.

C. Clear site of all vegetation as required for the Work.

D. Remove trees and shrubs.

E. Remove root system of trees and shrubs.

1.02 REGULATORY REQUIREMENTS

A. Conform to applicable codes for disposal of debris.

B. Coordinate clearing Work with utility companies.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

3.01 PREPARATION

A. Verify in Field with Engineer and Township's Landscape Review Consultant or other Township Representative that existing plant life and features designated to remain are clearly tagged or identified.

B. Confirm that all Erosion and Sedimentation Plan controls, if applicable, are in-place per the approved plans and obtain sign-off by the Bucks County Conservation District.

3.02 PROTECTION

A. Protect utilities that remain, from damage.

B. Protect trees and plant growth designated to remain as directed by Engineer and/or Township's Landscape Review Consultant

C. Protect benchmarks, features and existing structures from damage or displacement.

3.03 CLEARING

A. Clear areas required for access to site and execution of Work.

B. Remove paving, curbs, and/or rock as required to finish the Work.

C. Remove trees and shrubs, stumps, root systems and surface rock as required for the Work.

D. Clear undergrowth and deadwood without disturbing subsoil.

3.04 REMOVAL AND DISPOSAL

A. Remove from site and properly dispose of debris, rock, and extracted plant life.

END OF SECTION

SECTION 02202

ROCK REMOVAL

PART 1 GENERAL

1.01 WORK INCLUDED

A. Removal of discovered rock during excavation.

B. Use of explosives to assist rock removal.

1.02 RELATED WORK

A. Section 02205 - Excavation and Backfilling.

1.03 REFERENCES

A. NFPA 495 - Code for the Manufacture, Transportation, Storage, and Use of Explosive Materials.

B. Buckingham Township Code Enforcement Department Blasting Permit.

1.04 QUALITY ASSURANCE

A. Seismic Survey Firm: Company specializing in seismic surveys with five years documented experience.

B. Explosives Firm: Company specializing in explosives for disintegration of subsurface rock with five years documented experience.

1.05 REGULATORY REQUIREMENTS

A. Conform to Township, Commonwealth, Pa. DEP and PA DOT codes for explosive disintegration of rock.

B. Obtain permits from all authorities having jurisdiction before explosives are brought to site or drilling is started.

1.06 SUBMITTALS:

A. Obtain Township Blasting Permit and satisfy all requirements therein.

B. Submit two (2) copies of blaster's license to the Engineer.

C. Provide a descriptive procedure of either mechanical or blasting methods to the Engineer for review. Indicate all safety measures to be in effect during blasting operations.

D. Provide daily blasting reports to the Engineer and as required by Township.

E. Provide Blasting Bond as required by Township and/or other regulatory agency.

PART 2 PRODUCTS

2.01 MATERIALS

A. Rock (Definition): Solid mineral material with a volume in excess of 1/2 cu yd or rock that cannot be removed by a hydraulic excavator with a minimum manufacturer's operating weight of 41,000 pounds, 118 flywheel horsepower at 1800 rpm (Caterpillar E200 B EL equivalent or larger) and minimum 3 foot wide heavy duty bucket with rock teeth.

B. Explosives: Type recommended by explosives firm following seismic survey and required by authorities having jurisdiction.

C. Delay Devices: Type recommended by explosives firm.

D. Blasting Mat Materials: Type recommended by explosives firm.

PART 3 EXECUTION

3.01 INSPECTION

A. Verify sites conditions and note irregularities affecting work of this Section.

B. Beginning work of this Section means acceptance of existing condition.

3.02 ROCK REMOVAL - MECHANICAL METHOD

A. Excavate for and remove rock by the mechanical method.

B. Cut away rock at excavation bottom to form level bearing.

C. Remove shaled layers to provide sound and unshattered base for footings.

D. In utility trenches, excavate to 6 inches below invert elevation of pipe and to a width shown on the Contract Drawings or 24" total width if not specified.

E. Remove excavated material from site.

F. Correct unauthorized rock removal in accordance with backfilling and compaction requirements of Section 02225.

3.03 ROCK REMOVAL - EXPLOSIVES METHODS

A. Rock, if any, may be removed by light blasting, to the extent permitted or directed, with explosives of such power and in such quantities and positions as will neither crack nor damage the rock upon or against which masonry is to be built, and as will neither crack nor damage nearby existing structures. Blasting will not be permitted within twenty (15’) of existing masonry or within fifteen feet (15’) of any water or sewer pipeline. Whenever, in the opinion of the Engineer, further blasting is likely to injure the rock upon or against which the masonry may be built; or is likely to damage existing structures, related works, or new construction, blasting shall be discontinued and the excavated rock shall be continued by wedging and barring, by paving breaker, or other approved methods.

B. Blasting shall be conducted so as not to endanger persons or property, and whenever required, blasts shall be covered or otherwise satisfactorily confined. Contractor shall be held responsible for and shall make good any damage caused by blasting or accidental explosion.

C. Blasting for excavation will be permitted only after securing the written permission of the Township. The Township reserves the right to regulate the time of blasting. All handling of explosives and blasting operations shall be done by a workman qualified for this work and so licensed.

D. All blasting shall be conducted and governed by rules and regulations outlined by Pennsylvania DER in Title 25, Article IV, Chapter 21, entitled "Storage, Handling, and Use of Explosives" or as otherwise provided in the Township's rules and regulations.

END OF SECTION

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SECTION 02211

ROUGH GRADING

PART 1 GENERAL

1.01 WORK INCLUDED

A. Remove topsoil and stockpile for later reuse. Remove excess from site.

B. Excavate subsoil and stockpile for later reuse. Remove excess from site.

C. Grade and rough contour site.

1.02 PROJECT RECORD DOCUMENTS

A. Accurately record location of utilities remaining rerouted utilities, new utilities by horizontal dimensions, elevations or inverts, and slope gradients.

1.03 PROTECTION

A. Protect trees, shrubs, lawns, and other features remaining as portion of final landscaping.

B. Protect benchmarks, existing structures, fences, roads, sidewalks, paving, and curbs if not designated to be removed.

C. Protect above or below grade utilities which are to remain.

D. Repair damage.

PART 2 PRODUCTS

2.01 MATERIALS

A. Topsoil: Excavated material, graded free of roots, rocks larger than one-inch subsoil, debris and large weeds.

B. Subsoil: Excavated material, graded free of lumps larger than 6 inches, rocks larger than 3 inches and debris.

PART 3 EXECUTION

3.01 PREPARATION

A. Identify required lines, levels, contours and datum.

B. Identify known below grade utilities. Place Pa. One Call (POCS) notice. Stake and flag locations.

C. Identify and flag above grade utilities not marked by utility owners.

D. Maintain and protect existing utilities remaining which pass through work area.

E. Follow all POCS Rules and Regulations.

F. Obtain Erosion and Sedimentation (E & S) Permit from Bucks County Conservation District and permits from Pa. DEP and all other regulatory agencies having jurisdiction.

3.02 TOPSOIL EXCAVATION

A. Excavate topsoil from areas to be further excavated, relandscaped, or regraded and stockpile in area designated on-site. Remove excess topsoil not being reused from site as directed by Township and/or Engineer. Follow all conditions of E & S plan.

B. Do not excavate wet topsoil.

C. Stockpile topsoil and cover to protect from erosion. Follow all conditions of E & S plan.

3.03 SUBSOIL EXCAVATION

A. Excavate subsoil from areas to be relandscaped or regraded, mark areas and stockpile on-site. Remove excess subsoil not being reused from site as directed by Township and/or Engineer.

B. When excavation through roots is necessary, perform work by hand and cut roots with a sharp axe or as directed by Township Landscape Consultant and/or Engineer.

3.04 TOLERANCES

A. Top Surface of Sub-grade: Plus or minus one inch.

END OF SECTION

SECTION 02218

LANDSCAPE GRADING

PART 1 GENERAL

1.01 WORK INCLUDED

A. Finish grade subsoil.

B. Place, level, and compact topsoil.

1.02 PROTECTION

A. Protect landscaping and other features remaining as final work as directed by Township Landscape Consultant and/or Engineer.

B. Protect existing structures, fences, roads, sidewalks, paving, and curbs.

PART 2 PRODUCTS

2.01 MATERIALS

A. Topsoil: Reused.

PART 3 EXECUTION

3.01 INSPECTION

A. Verify site conditions and note irregularities affecting work of this Section.

B. Submit detailed plan to Engineer for review with Landscape Consultant and approval.

B. Beginning work of this Section means acceptance of existing conditions.

3.02 SUBSOIL PREPARATION

A. Eliminate uneven areas and low spots. Remove debris, roots, branches and stones in excess of 1 inch in size. Remove soil contaminated with petroleum products as directed by Engineer and permitted by Pa. DEP.

B. Scarify subgrade to depth of three inches where topsoil is scheduled. Scarify in areas where equipment used for hauling and spreading topsoil has compacted subsoil.

3.03 PLACING TOPSOIL

A. Place topsoil to minimum depth of 6 inches in areas where seeding or planting is scheduled.

B. Use topsoil in relatively dry state. Place during dry weather.

C. Fine grade topsoil eliminating rough or low areas. Maintain levels, profiles, and contours required for work.

D. Remove stone, roots, grass, weeds, debris, and foreign material while spreading.

E. Manually spread topsoil around trees and structures to prevent damage.

F. Lightly compact placed topsoil.

G. Remove surplus subsoil from site as directed by Township Landscape Consultant and/or Engineer.

H. Spread surplus topsoil over site as directed by Township Landscape Consultant and/or Engineer.

I. Leave stockpile area and site clean and raked, ready to receive landscaping.

3.04 TOLERANCES

A. Top of Topsoil: Plus or minus 1/2 inch.

END OF SECTION

SECTION 02222

EXCAVATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Work under this section shall include all labor, materials, equipment and services as required to excavate the site for construction for all site structures.

1.02 FIELD MEASUREMENTS

A. Verify that survey benchmark and intended elevations for the Work are as indicated.

1.03 DEFINITIONS

A. *Excavation* shall include any material encountered, including surface pavement, removed to the depth of the outside bottom (called "grade") of pipe and manholes, plus the extra digging to the depth (called "subgrade") required for bedding, and to the grade depth for structures.

B. *Extra Excavation* shall include excavation below subgrade or grade as required by the Engineer because of poor bearing soil or underground utilities or similar unforeseen conditions.

C. *Extra Rock Excavation* shall mean rock excavation required for reasons similar to those under B above.

1.04 CODES

A. All excavation work shall be performed in accordance with:

1. Commonwealth of Pennsylvania Department of Labor and Industry "Regulations for Trenches and Excavations" latest edition.

2. All local, state, and other laws and regulations governing blasting.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

3.01 PREPARATION

A. Identify required lines, levels, contours and datum.

3.02 EXCAVATION

A. Excavation Limits

1. Trenches shall be dug to depths and widths as specified herein or as approved or directed by the Engineer. Sides of trenched shall be as nearly vertical as possible.

2. Trenches shall be excavated true to line so that a clear space of eight inches (8") is provided on each side of the pipe bell to a height not less than the top of the pipe. These dimensions are applicable to the inside face of sheeting, if such is required at the elevation of the pipe. Trenches may be wider above the top of the pipe.

3. When width below top exceeds bell plus 16 inches, the Engineer may call for stronger pipe at no expense to the Owner or Township.

4. Where a section of trench has, by the Contractor's own mistake, been excavated to a greater depth than specified, it shall be brought to the proper grade using 2A crushed stone compacted to a minimum 90% Standard Proctor Density. Furnishing and placing of this stone shall be at the Contractor's expense.

5. The Engineer shall have the right to limit amount of trench opened in advance of completed sewer. Excavation shall be completed at any location, except for final grading and shaping, a minimum of twenty feet (20') in advance of pipe installation. This amount of pipe laid in advance of backfilling shall not exceed one hundred feet (100').

6. Excavation limits for manholes and structures shall be to the minimum horizontal limits in which a man can work efficiently. Excavation for footings shall be to outside footing dimensions and the footing poured around without side forms.

7. Pipe trenches and manholes (when they have pre-cast bases) shall be excavated six inches (6") deeper than elevations shown on the plans in order to provide space for bedding.

B. Disposition of Excavated Material

1. The Contractor shall classify, separate and store materials as may be required for re-use in backfilling, re-paving or replacing topsoil. If the Contractor prefers not to separate surface materials, he shall furnish replacement materials of at least equal quantity and quality as directed to replace displaced material.

2. Excavated material shall be placed so as not to interfere with traffic on streets and driveways in an unreasonable manner.

C. Trench De-Watering

1. All excavations shall be free of water during construction of structures, pipe laying and backfilling operations. The Contractor shall provide and place all necessary flumes, channels or pipes required to temporarily divert water from the excavation. All water from any source shall be pumped or bailed to provide a dry hole. All water pumped from the excavation shall be discharged in such manner as shall not cause injury to work completed, damage to property, health hazards, soil erosion or impediment of traffic. In no case shall water be permitted to rise into or

flow through a completed sanitary sewer.

D. Underground Utilities and Structures

1. The presence, location, character, and size of existing underground features, if any, shown on the drawings is in accordance with the best available information. The Contractor shall be responsible for determining the exact location of utilities and underground structures. Place Pa. One Call (POCS) notice. Encountering other underground installations not shown on the drawings shall not constitute basis for a claim by the Contractor for damage or extra compensation, for either delay or extra work.

2. All utility services encountered shall be supported by timber struts or by other suitable means approved by the respective utility owner. Utilities or other structures located transversely across the trench shall be protected from damage or displacement.

E. Rock Excavation

1. Rock excavation shall be accomplished by drilling and wedging or blasting as permitted by the Township (see 02202). Rock shall be fully taken out at least twenty-five feet (25') in advance of pipe laying. The bottom width shall not exceed the widths of the trench for the specified pipe. When rock is found in spots so that hard rock areas alternate with softer earth areas, the rock shall be excavated an extra six inches (6") below subgrade. The bottom of the excavated trench shall be raised to subgrade elevation with crushed stone and the cost of this material shall be included in the unit bid price for sewer construction. Stretches of rock extending between manholes need, however, be excavated only to normal subgrade depth.

2. All excavated rock material, which is unfit for backfilling shall be immediately removed from the site at the Contractor's expense and as Directed by Engineer.

F. Shoring

1. Excavation for pipe and structures shall be properly and adequately shored as required by the Occupational Safety and Health Administration (OSHA).

2. All sheeting and bracing which may not be left in place under the foregoing provisions of these specifications shall be removed in such manner as not to endanger other structures. All voids left, or caused by, withdrawals of sheeting shall be immediately refilled with sand by ramming with tools especially adapted to such purpose, by watering, or otherwise as may be directed. The cost of furnishing, placing, and removing such sheeting and bracing shall be included in the unit price bid for sewers.

G. Protection of Trees

1. Where trees are within eight feet (8') of the centerline of the trench and are not indicated to be removed, they shall be protected by boards wired to the trees to prevent scarring of the bark. Where branches of the trees hang over the trench or are sufficiently close to be hit by the boom of the backhoe, such limbs shall be neatly sawed off at the tree truck or otherwise protected to prevent breaking of the limb at junction with the trunk.

H. Error in Excavation

1. Contractor shall excavate to the elevations shown on the plans, or as directed by the Engineer. If the Contractor excavates below elevations specified for trenches, he shall bring the excavation back to proper elevation (except as hereinafter noted) by backfilling with #2 stone, free of organic matter, and tamping to provide a compact base. Backfill material must be approved by the Engineer before being placed.

2. If the Contractor excavates below elevations specified for footings or for other structures, the Engineer may require that he shall not backfill the excavation to bring it to proper elevation, but the footings or other structures will be revised to meet the new grades caused by the Contractor's over excavation. In these cases, and for any other structure designated by the Engineer, the footings must bear on undisturbed soil or rock.

3. Any increase in cost resulting from backfilling or increasing the size of footings or foundations because of over-excavation shall be borne by the Contractor at no expense to the Owner.

3.03 FIELD QUALITY CONTROL

A. Provide field tests of bearing surfaces to assure minimum required bearing capacity.

B. Submit 2 copies of reports to Engineer prior to construction.

3.04 PROTECTION

A. Protect excavations by methods required to prevent cave-in or loose soil from falling into excavation.

B. Protect bottom of excavations from freezing.

END OF SECTION

SECTION 02223

STRUCTURAL BACKFILL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Building perimeter backfilling to subgrade elevations.

B. Site filling and backfilling.

C. Consolidation and compaction.

D. Fill for over-excavation.

1.02 RELATED SECTIONS

A. Section 01400 - Quality Control: Testing Fill compaction.

B. Section 02225 - Trenching: Backfilling of utility trenches.

C. Section 03301 - Cast-in-Place Concrete: Concrete materials.

1.03 REFERENCES

A. ANSI/ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregates.

B. ANSI/ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb (2.49 kg) Rammer and 12 inch (304.8 mm) Drop.

1.04 SUBMITTALS

A. Submit under provisions of Section 01300.

PART 2 PRODUCTS

2.01 FILL MATERIALS

A. Type 2RC Crushed stone; free of shale, clay, friable material, sand, debris; graded in accordance with ANSI/ASTM C136 within the following limits: Penn Dot Type 2RC aggregate.

B. Type 2B crushed stone; washed, free of clay, shale, organic matter; graded in accordance with ANSI/ASTM C136, to the following: Penn Dot 2B aggregate.

C. Type C - Sand: Natural river or bank sand; free of silt, clay, loam, friable or soluble materials, or organic matter; graded in accordance with ANSI/ASTM C136, within the following limits: Penn Dot Type C Sand

D. Type B - Penn Dot Type B Fine Aggregate.

E. Subsoil: Reused, free of gravel larger than 3 inch size, and debris.

2.02 ACCESSORIES

A. Geotextile Fabric: Dupont Typar 3401 or approved equal.

B. Vapor Retardant: 6 mil thick, polyethylene.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify fill materials to be reused are acceptable.

3.02 PREPARATION

A. Generally, compact subgrade to density requirements for subsequent backfill materials.

B. Cut out soft areas of subgrade not capable of insitu compaction. Backfill with Type 2RC fill and compact to density equal to or greater than requirements for subsequent backfill material.

C. Prior to placement of aggregate at paved areas, compact subsoil to 95 percent of its maximum dry density in accordance with ANSI/ASTM D698.

3.03 BACKFILLING

A. Backfill areas to contours and elevations with unfrozen materials.

B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.

C. Place geotextile fabric prior to placing 2RC aggregate.

D. Granular Fill: Place and compact materials in continuous layers not exceeding 6 inches compacted depth.

E. Soil Fill: Place and compact material in continuous layers not exceeding 8 inches compacted depth.

F. Employ a placement method that does not disturb or damage utilities in trenches.

G. Maintain optimum moisture content of backfill materials to attain required compaction density.

H. Backfill against supported foundation walls. Do not backfill against unsupported foundation walls.

I. Backfill simultaneously on each side of unsupported foundation walls until supports are in place.

J. Slope grade away from building minimum 2 inches in 10 ft unless noted otherwise.

K. Make grade changes gradual. Blend slope into level areas.

L. Remove surplus backfill materials from site.

M. Leave fill material stockpile areas completely free of excess fill materials.

3.04 TOLERANCES

A. Top Surface of Backfilling Under Paved Areas: Plus or minus one inch from required elevations.

3.05 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Section 01400.

B. Tests and analysis of fill material will be performed in accordance with ANSI/ASTM D698 and with Section 01400.

C. Compaction testing will be performed in accordance with ANSI/ASTM D698 and with Section 01400.

D. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.

E. Frequency of Tests: As directed by Engineer.

F. Proof roll compacted fill surfaces, under slabs-on-grade and paving.

3.06 PROTECTION OF FINISHED WORK

A. Protect finished Work under provisions of Section 01500.

B. Recompact fills subjected to vehicular traffic.

3.07 SCHEDULE

A. Interior Slab-On-Grade:

1. Type 2B fill, 4 inches thick.

B. Exterior Side of Foundation Walls.

1. Subsoil fill, to subgrade elevation, each lift, compacted to 90 percent.

C. Fill Under Grass Areas:

1. Subsoil fill, to 6 inches below finish grade.

D. Fill Under Concrete Paving:

1. Type 2B fill, to 8 inches below finish paving elevation, compacted to 95 percent.

E. Fill to Correct Over-excavation:

1. Lean concrete to minimum compressive strength of 1000 psi.

END OF SECTION

SECTION 02224

LAGOON CONSTRUCTION WITH GEOMEMBRANE LINER

PART 1 GENERAL

1.01 SCOPE

A. The following describes parameters for the manufacture, supply, and installation of geomembranes. All procedures, operations, and methods shall be in strict in accordance with the engineer's specifications, plans, and drawings.

1.02 QUALIFICATIONS OF CONTRACTOR WORK ACTIVITIES

A. Manufacturing

1. The manufacturer shall have at least five (5) years continuous experience in the manufacture of geomembrane and/or experience totaling 10,000,000 square feet of manufactured geomembrane.

B. Installation

1. The installation contractor shall be the manufacturer or a dealer trained to install the manufacturer's geomembrane.

2. Installation shall be performed under the constant direction of a field installation supervisor who shall remain on site and be responsible, throughout the liner installation, for liner layout, seaming, testing, repairs, and all other activities by the Installer. The field installation supervisor shall have installed or supervised the installation of a minimum of 1,000,000 square feet of geomembrane and be certified by the liner manufacturer. Seaming shall be performed under the direction of a master seamer (who may also be the field installation supervisor) who has seamed a minimum of 1,000,000 linear feet of geomembrane, using the same type of seaming apparatus specified for this project. The field installation supervisor and/or master seamer shall be present whenever seaming is performed.

1.03 SUBMITTALS

A. Manufacturer

1. The manufacturer shall provide the following information:

a. List of material properties.

b. Manufacturing quality control program.

c. Copy of quality control certificates issued by the resin supplier.

d. Copy of quality control certificates for the geomembranes in conformance with Section 2.4.3.

B. Installation Contractor

1. The installer shall provide the following written information:

a. A list of completed facilities, totaling a minimum of 1,000,000 square feet for which the installer has installed geomembrane. For each installation, the following information shall be provided:

1) Name and purpose of facility, location, and date of installation.

2) Name of owner, design engineer, manufacturer, and name and telephone number of contact at the facility that can discuss the project.

3) Thickness and quantity of the installed geomembrane.

2. Submittals Prior to Commencement of Installation

a. Proposed installation panel layout.

b. Resume of the field installation supervisor and master seamer.

c. Written plan for dewatering and disposal of water and any residual waste contained therein.

1.04 MEETING

A. A daily meeting shall be held at the work area just prior to commencement of the work to discuss work activities. The earthwork contractor, the liner installer and the inspector shall be present.

1.05 WARRANTY

A. A written Warranty shall be obtained from the manufacturer (for material) and the installation contractor (for workmanship). These documents shall warrant both the quality of the material and workmanship for 15 years material and 5 years workmanship.

1.05 INSPECTION SERVICES

A. Owner shall employ services of an independent firm to perform inspection of the installation.

B. The independent firm will perform inspections, witness any tests, and other services specified in individual specification Sections and as required by the Engineer.

C. Reports will be submitted by the independent firm to the Engineer with a copy to the owner indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.

Results of all tests taken, both passing and failing tests, shall be recorded in the report for the date taken. Specification paragraph reference, location where tests were taken, and the sequential control number identifying the test shall be given. If approved by the Engineer, actual test reports may be submitted later with a reference to the test number and date taken. An information copy of tests performed by an offsite or commercial test facility shall be provided directly to the Engineer with a copy to owner.

D. Cooperate with independent firm; furnish samples of materials, equipment, tools storage and assistance as requested.

PART 2 PRODUCTS

2.01 EMBANKMENT MATERIALS

A. The on-site excavated materials (excluding topsoil, heavy clay, ice and frozen materials) having a maximum particle size of 4 inches shall be utilized for construction of the lagoon embankments and bottoms.

B. If borrow material is required for completion of the embankments, these soils shall conform to the requirements of SM, ML, SC, or ML-CL as defined by the Unified Soil Classification system (ASTM D2487). Laboratory verification, and approval by the Engineer, shall be obtained before placement of these materials.

2.02 MATERIALS

A. The geomembrane shall be chlorosulfonated polyethylene (CSPE)-based synthetic rubber (Hypalon) as manufactured by Stevens Geomembranes Inc.

B. Metal battens or banding and hardware shall be stainless steel.

C. Field chemical fusion material shall be Stevens Aqua-weld or D-3 Hypalon Chemical Fusion Solution.

2.03 GEOMEMBRANE PHYSICAL PROPERTIES

A. Hypalon geomembranes shall be designed to meet the following performance parameters:

Sheet Properties	Test Method	Standard	Metric
Gauge, nominal	-	36-mil	.9mm
Plies, reinforcing	-	1	1
Thickness, minimum	ASTM D-751	34 mil	.86mm
Overall Over scrim	Optical Method	11 mil	0.28mm
Breaking strength-fabric, minimum Elongation at yield, %	ASTM D-751Method A	200 lbf	89 kN
Tear strength, minimum	ASTM D5884	70 lbf	0.31 kN
Puncture resistance, minimum	FTMS 101CMethod 2031	190 lbs	0.84 kN
Hydrostatic resistance, minimum	ASTM D-751Method A Procedure 1	350 psi	2.4 Mpa
Dimensional stability, maximum, % change	ASTM 12041 hr. @ 180°F (82°C)	2%	2%
Low temperature flexibility	ASTM D-21361/8" Mandrel 4 hr. pass	-40°F	-40°C
Ply adhesion, minimum	ASTM D-413 Machine Method Modified	7 lbs/in . 10 lbs/in	1.2 kN/m 1.75 kN/m
UV resistance	ASTM G26 Xenon Arc 4000 hrs. @80°C	PASS	PASS

B. Fabricated Seam Properties shall be designed to meet the following performance parameters:

Seam Property		Standard	Metric
Bonded seam strength, minimum	ASTM D-751 Modified	160 lbf	0.71 kN
Peel adhesion, minimum	ASTM D-413 Modified	10 lbs/in or FTB	1.75 kN/m

2.04 GEOMEMBRANE ROLLS

A. The geomembrane shall be 36 mil (0.9mm) and provided in rolls 76.5" wide x 900' long (1.94m x 274m).

B. The surface of the smooth geomembrane shall not have striations, roughness, pinholes, or bubbles.

C. The geomembrane shall be supplied in rolls. Labels on each roll shall identify the thickness of the material, the length and width of the roll, lot and roll numbers, and name of manufacturer.

2.05 LINER SOIL COVER

A. Please refer to Section 02228 "Cover Material Placement" for liner soil requirements.

2.05 RIP-RAP

A. The aggregate shall be open-graded riprap as described by the National Stone Association.

2.06 GEOTEXTILE FABRIC

A. The geotextile fabric is a continuous long-chain synthetic polymer, non-woven fabric. The fabric weight will be at least 8 oz. per sq. yd as defined by ASTM B 3776. Field conditions as determined by the inspector in consultation with the installer may warrant 11 oz geotextile fabric, which will be supplied at no extra cost.

B. The geotextile fabric shall be TNS E080 as manufactured by TNS Advanced Technologies or approved equal.

PART 3 EXECUTION

3.01 INITIAL SITE PREPARATION

A. Initial Lagoon site preparation shall consist of stripping of all topsoil, vegetation, and organic material from entire area of construction. Topsoil shall be stockpiled in a location designated on the Drawings for future use in the Project.

3.02 LAGOON

A. General

1. The owner's representative (soil quality assurance inspector) shall inspect the subgrade preparation. Prior to liner installation the subgrade shall be compacted in accordance with the project specifications. Weak or compressible areas, which cannot be satisfactorily compacted, must be removed and replaced with properly compacted fill. All surfaces to be lined shall be smooth, free of all foreign and organic material, sharp objects, or debris of any kind. The subgrade shall provide a firm unyielding foundation with no sharp changes or abrupt breaks in grade. Standing water or excessive moisture shall not be allowed.

2. The inspector, on a daily basis, shall approve the surface on which the geomembrane will be installed. After the supporting soil surface has been approved, it shall be the installer's responsibility to indicate to the inspector any changes to its condition that may require repair work.

3. Lagoon Site: The exposed embankment subgrade and lagoon bottom subgrade areas shall be compacted to at least 95 percent of the maximum dry density as determined by the Standard Proctor Test (ASTM D698). The moisture content at the time of compaction shall not vary from the optimum moisture content by more than three percentage points. Soft or organic areas detected during subgrade preparation shall be over-excavated and backfilled with compacted fill as described below. Any signs of groundwater or other unexpected subsurface conditions shall immediately be brought to the Engineer's attention.

4. Embankment Construction: Embankment materials shall be placed in uniform, maximum 8" loose lifts and compacted to at lease 95 percent of the maximum dry density as determined by the Standard Proctor Test (ASTM D698). The moisture content at the time of compaction shall not vary from the optimum moisture by more than three percentage points. The surface to receive the liner shall be smooth and free of debris, roots and angular or sharp rocks. Over-excavate 18" of soft subgrade areas not suitable for in-situ compaction in lagoon bottom and slopes and replace with suitable embankment fill.

B. Vegetation Control

1. The general contractor, if necessary, shall sterilize the area using an effective soil sterilant specifically formulated for vegetation present in the area. The sterilant shall not be harmful to the liner and shall be applied according to the recommendations of its manufacturer. Sterilant must be approved, if possible as part of the shop drawing submittals.

C. Anchor Trench

1. The anchor trench should be excavated to the line, grade, and width shown on the project construction drawings, prior to liner system placement. Slightly rounded corners shall be provided in the trench to avoid sharp bends in the geomembrane.

D. Inspection and Testing

1. An independent testing agency approved by the Owner and paid for by the Contractor will perform field inspection and testing under the provisions of Section 01400.

2. All field inspection and testing shall be performed under the supervision and review of a Professional Engineer licensed in the State of Pennsylvania and employed by the testing agency.

3. The testing agency's responsibilities during earthwork construction will include:

   a. Laboratory testing of bulk samples to determine soil classifications and moisture-density relations for various soil types.

   b. Observation, testing, and approval of subgrades to receive compacted fill for embankment and liner support.

   c. Full-time observations of excavation fill placement and field density testing of compacted fill.

   d. Daily reports of observations and testing activities. Submit to Engineer each day.

4. In-place field density testing shall be in accordance with the sand-cone test method (ASTM D-1556) and/or the nuclear test method (ASTM D-2922). Where the nuclear test method is utilized, adequate correlations with the sand-cone test method must be made to verify the accuracy of nuclear tests.

5. Provide for the bottom subgrade a minimum of two tests per 5,000 square feet indicating adequate compaction. For the embankments,

tests shall be performed on each lift, with a minimum of one test per 10,000 square feet indicating adequate compaction. Also, additional tests shall be performed at the Engineer's direction.

If the additional test results show the Work does not meet specified requirement, the test shall be at the Contractor's expense and the cost shall be deducted from the Contract Sum/Price. The Owner shall bear the cost of additional tests which confirm Work meets specifications.

6. If the tests indicate Work does not meet specified requirements, the Contractor shall correct the area and retest at no cost to the Owner.

E. Contractor is responsible for disposal of excess material from the site.

3.02 MATERIAL LOGISTICS

A. Transportation and On-site Storage

1. The geomembrane rolls shall be shipped by trailer truck to job site. The geomembrane shall be stored so as to be protected from puncture, dirt, grease, moisture and excessive heat. The damaged material shall be stored separately for replacement. The rolls shall be stored on a prepared smooth surface (not wooden pallets) and not be stacked more than two rolls high.

B. Dewatering

1. Installer is responsible for dewatering impoundment(s) to be lined both initially and during progress of the work and providing all necessary pumps, hoses fittings and the like to keep the impoundment(s) and work areas free of ponded water as directed by the engineer or owner. Disposal of any residual waste and the water shall be in accordance with all applicable law and regulatory guidelines and as approved by the engineer or owner.

3.03 METHOD OF PLACEMENT

A. The rolls shall be deployed using a spreader bar assembly attached to a loader bucket of by other methods approved by the project engineer.

B. The installer is responsible for the following:

1. Equipment or tools shall not damage the geomembrane during handling, transportation and deployment.

2. Personnel working on the geomembrane shall not smoke or wear damaging shoes.

3. The method used to unroll the panels shall not cause scratches or crimps in the geomembrane and shall not damage the supporting soil.

Inspector shall reject installation areas that do not meet the above and installer shall remove and replace the areas rejected.

4. Adequate loading (e.g., sand bags or similar items that will not damage the geomembrane) shall be placed to prevent uplift by wind (in case of high winds, continuous loading is recommended along edges of panels to minimize risk of wind flow under the panels).

C. Weather Conditions

1. Geomembrane deployment shall proceed between ambient temperatures of 32° F to 104° F. Placement can proceed below 32° only after it has been verified by the inspector that the material can be seamed according to the specification. Geomembrane placement shall not be done during any precipitation, in the presence of excessive moisture (e.g., fog, rain, dew) or in the presence of excessive winds, as determined by the inspector after consultation with the installation supervisor.

3.04 FIELD SEAMING

A. Approved seaming processes are fusion and extrusion welding. On side slopes, seams shall be oriented in the general direction of maximum slope, i.e., oriented down, not across the slope. In corners and odd-shaped geometric locations, the number of field seams shall be minimized.

B. No base T-seam shall be closer than 5 feet from the toe of the slope. Seams shall be aligned with the least possible number of wrinkles and "fishmouths". If a fishmouth or wrinkle is found, it shall be relieved and cap-stripped.

C. Seam Overlap

1. Geomembrane panels must have a finished minimum overlap of 4 inches for fusion welding and 6 inches for extrusion welding.

2. Cleaning solvents may not be used unless the liner manufacturer approves the product.

D. Seaming Equipment and Accessories

1. Equipment approved for field seaming are fusion welders and extrusion fillet welders.

a. Fusion Welder, 110 Volt (220 Volt).

b. Extrusion Welder, 220 Volt.

c. High-speed, 10,000 rpm, 41/2-inch side grinder with 80-grit discs.

d. Generator, single-phase with 110/200 Volt Outputs.

e. Power Cord, minimum S.O. type, 12 gauge O.S.H.A. approved electrical cord with O.S.H.A. approved twist-type plugs and connections.

f. Vacuum Box Test Equipment for non-destructive seam testing.

g. Air pressure test equipment for non-destructive seam testing.

h. Field Tensiometer, capable of performing quantitative shear and peel tests.

E. Test Seams

1. Field tests of seams shall be conducted on the liner to verify that seaming conditions are satisfactory. Test seams shall be conducted at the beginning of each seaming period and at least once each 4 hours, for each seaming apparatus and personnel used that day.

2. All test seams shall be made in contact with the subgrade. Welding rod used for extrusion welding shall have the same properties as the resin used to manufacture the geomembrane. The test seam samples shall be 10 feet long for fusion welding and 3 feet long for extrusion welding with the seam centered lengthwise. Five specimens shall be cut from each end of the test seams by the inspector. The inspector shall use a tensiometer to test 5 specimens for shear and 5 specimens for peel. Each specimen shall be one inch wide with a grip separation of 4 inches plus the width of the seam. The seam shall be centered between the clamps. The rate of grip separation shall be 2 inches per minute. Test results for seam strength properties shall be the average of five specimens. Four out of five specimens shall pass seam acceptance criteria. Shear and peel tests shall return in Film Tearing Bond (FTB), which is a failure in ductile mode of one of the bonded sheets by tearing prior to complete separation in the bonded area. If a test seam fails to meet field seam specifications, the seaming apparatus and/or seamer shall not be used for seaming until the deficiencies are corrected and a successful test seam is achieved.

F. Non-Destructive Seam Testing

1. The installer should non-destructively test all field seams over their full length.

a. Vacuum Box Testing

1) Equipment for testing extrusion seams shall be comprised of the following:

2) A vacuum box assembly consisting of a rigid housing, a transparent viewing window, a soft rubber gasket

attached to the bottom, port hole or valve assembly, and a vacuum gauge.

3) Soapy solution in a plastic bucket with a mop.

b. The following procedures shall be followed by the installer:

1) Excess sheet overlap shall be trimmed away.

2) Wet a strip of geomembrane approximately 12 inches by the length of box with the soapy solution.

3) Place the box over the wetted area and compress.

4) Create a vacuum of 3 - 5 psi.

5) Ensure that a leak tight seal is created.

6) For a period of approximately 15 seconds, examine the geomembrane through the viewing window for the presence of animated soap bubbles.

7) If no animated bubbles appear after 15 seconds, close the vacuum valve and open the bleed valve, move the box over the next adjoining area with a minimum 3 inches overlap and repeat the process.

8) All areas where animated soap bubbles appear shall be marked, repaired and then retested.

c. The following procedures shall apply to locations where seams cannot be non-destructively tested.

1) If the seam is accessible to testing equipment prior to final installation, the seam shall be non-destructively tested prior to final installation.

2) If the seam cannot be tested prior to final installation, the seams shall be spark tested according to the spark tester manufacturer's procedures.

G. Destructive Seam Testing

1. Destructive seam testing should be minimized to preserve the integrity of the liner. The installer shall provide the inspector with one destructive test sample per project specifications (once per 500 feet of seam length unless otherwise directed by inspector) from a location specified by the inspector.

2. Sampling Procedure

a. In order to obtain test results prior to completion of liner installation, samples shall be cut and marked by the installer as the seaming progresses. The installer shall also record the date, location, and pass or fail description. all holes in the geomembrane resulting from obtaining the seam samples shall be immediately patched and vacuum tested.

3. Size and Disposition of Samples

a. The samples shall be 12 inches wide by 36 inches long with the seam centered length wise. The sample shall be cut into three equal-length pieces, one to be given to the inspector, one to be given to the owner and one to the installer.

4. Field Laboratory Testing

a. The inspector shall test ten 1 inch wide specimens from his sample, five specimens for shear strength and five for peel strength. To be acceptable all five specimens must pass the project seam requirements unless inspector determines that 4 out of 5 passes will be accepted after reviewing the test conditions and results.

5. Independent Laboratory Testing

a. The owner, at his discretion and expense, may send seam samples to a laboratory for testing. The test method and procedures to be used by the independent laboratory shall be the same as used in field-testing.

6. Procedures for Destructive Test Failure

a. The following procedures shall apply whenever a sample fails the field destructive test:

b. The installer shall cap strip the seam between the failed location and any passed test locations.

c. The installer can retrace the welding path to an immediate location (usually 10 feet from the location of the failed test), and take a sample for an additional field test. If this test passes, then the seam shall be cap stripped between that location and the original failed location. If the test fails, then the process is repeated.

d. Over the length of seam failure, the installer shall either cut out the old seam, reposition the panel and reseam, or add a cap strip.

H. Defects And Repairs

1. All seams and non-seam areas of the geomembrane shall be inspected by the inspector for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. The surface of the geomembrane shall be clean at the time of inspection.

2. Evaluation

   a. Each suspect location in seam and non-seam areas shall be non-destructively tested as appropriate in the presence of the inspector. Each location that fails the non-destructive testing shall be marked by the inspector, and repaired accordingly.

3. Repair Procedures

   a. Defective seams shall be cap stripped or replaced.

   b. Extrusion welding shall repair small holes. If the hole is larger than 1/4 inch, it shall be patched.

   c. Patching shall repair tears. If the tear is on a slope or an area susceptible to stress and has a sharp end it must be rounded prior to patching.

   d. Patches shall repair blisters, large cuts and undispersed raw materials.

   f. Extrusion welding shall employed on patches. The weld area shall be ground no more than 10 minutes prior to welding. No more than 10% of the thickness shall be removed by grinding. Welding shall commence where the grinding started and must overlap the previous seam by at least 2 inches. Reseaming over an existing seam without regrinding shall not be permitted. The welding shall restart by grinding the existing seam and rewelding a new seam.

   g. Patches shall be round or oval in shape, made of the same geomembrane, and extend a minimum of 6 inches beyond the edge of defects.

4. Verification of Repairs

   a. Each repair shall be non-destructively tested. Repairs that pass the non-destructive test shall be taken as an indication of an adequate repair. Failed tests indicate that the repair shall be repeated and retested until passing test results are achieved.

   b. The inspector shall keep daily documentation of all non-destructive and destructive testing. This documentation shall

identify all seams that initially failed the test and include evidence that these seams were repaired and successfully retested.

3.05 PENETRATIONS

A. For any penetrations or structures the liner will contact, connect the liner in a manner recommended by the manufacturer. Recommendations shall be part of the shop drawing submittal and approval process.

3.06 BACKFILLING OF ANCHOR TRENCH

A. The anchor trench shall be backfilled by the general contractor. Trench backfill material shall be placed and compacted in accordance with the project specifications.

B. Care shall be taken when backfilling the trenches to prevent any damage to the geomembrane. If damage occurs, it shall be repaired prior to backfilling.

3.08 GEOMEMBRANE ACCEPTANCE

A. The installer shall retain all ownership and responsibility for the geomembrane and the work until acceptance by the owner.

B. Final acceptance is when all of the following conditions are met:

1. Installation is finished.

2. Verification of the adequacy of all filled seams and repairs, including associated testing, is complete.

3. Lagoon has been checked for leaks.

END OF SECTION

SECTION 02225

TRENCHING/BACKFILLING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Excavate trenches for utilities from outside building to existing utilities.

B. Compacted bedding under pipe, and fill over utilities to subgrade elevations.

C. Backfilling and compaction.

1.02 RELATED SECTIONS

A. Section 01400- Quality Control: 01410 - Testing Laboratory Services: Testing fill compaction.

B. Section 02202 - Rock removal: Removal of rock during excavation.

C. Section 15400: Piping from building to existing utilities.

D. Section 03001 - Cast-in-Place Concrete: Concrete materials.

1.03 REFERENCES

A. ANSI/ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregates.

B. ANSI/ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb (2.49 kg) Rammer and 12 inch (304.8 mm) Drop.

1.04 SUBMITTALS

A. Submit under provisions of Section 01300.

1.05 FIELD MEASUREMENTS

A. Verify that survey benchmark and intended elevations for the Work are as shown on Drawings.

PART 2 PRODUCTS

2.01 FILL MATERIALS

A. Type 2RC Crushed Stone; free of shale, clay, friable material, sand, debris; graded in accordance with ANSI/ASTM C136 within the following limits: Penn Dot Type 2RC aggregate.

B. Type 2B crushed stone; washed, free of clay, shale, organic mater; graded in accordance with ANSI/ASTM C136, to the following: Penn Dot 2B aggregate.

C. Type B- Penn Dot Type B Fine Aggregate.

D. Subsoil: Reused, free of gravel or stone larger than 3 inch size, and free of any debris.

E. All Penn Dot standards referenced shall be per those in effect at the time of construction.

2.02 ACCESSORIES

A. Geotextile Fabric: Dupont Typar 3401 or approved equal.

B. Vapor Retardant: 6 mil thick, polyethylene.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify fill materials to be reused, is acceptable.

3.02 PREPARATION

A. Identify required lines, levels, contours, and datum.

B. Maintain and protect existing utilities remaining, which pass through work area.

C. Protect plant life, lawns, and other features remaining as a portion of final landscaping.

D. Protect bench marks, existing wells, sidewalks, paving, and curbs from excavation equipment and vehicular traffic.

E. Protect above and below grade utilities, which are to remain.

F. Cut out soft areas of subgrade not capable of insitu compaction. Backfill with Type 2B fill and compact to density equal to or greater than requirements for subsequent backfill material.

3.03 EXCAVATION

A. Excavate subsoil as required for electric conduit to existing utilities.

B. Cut trenches sufficiently wide to enable installation of utilities and allow inspection.

C. Excavation shall not interfere with normal 45 degree bearing splay of foundations.

D. Remove lumped subsoil, boulders, and rock up to 1/3 cu yd, measured by volume. Larger material will be removed under Section 02202.

E. Correct unauthorized excavation at no cost to Owner.

F. Correct areas over-excavated by error in accordance with Section 02222.

G. Stockpile excavated material in area designated on site and remove excess material not being used from site.

3.04 BEDDING

A. Support pipe and conduit during placement and compaction of bedding fill.

3.05 BACKFILLING

A. Backfilling includes all refilling of excavation and compaction for pipe trenches and around structures. Backfilling may be done as promptly as possible without damage to pipe or structures in place. Backfilling shall be done only with permission of Engineer. No backfill shall be deposited against concrete until the concrete has set. Compaction of backfill against concrete structures shall not be carried out by motorized equipment closer to structure than the depth of the structure below grade.

B. Backfill trenches to contours and elevations with unfrozen materials. Do not backfill over porous, wet, frozen or spongy subgrade surfaces. Trench must be dewatered.

C. Place geotextile fabric over Type 2B fill prior to placing next lift of fill in roads and under pavement.

D. 2 RC Fill: To be used in all roadways, parking areas or other vehicle access areas. On all state and Township roads and streets, Form 408 shall apply for final backfill and compaction. (Latest edition) or as otherwise provided in Township Road opening permit. Use only 2RC stone or approved equal beneath, around and over buried pipe or conduit per section 3.09. Place and compact materials in continuous layers not exceeding 6 inches compacted depth.

E. Soil Fill: Place and compact material in continuous layers not exceeding 8 inches compacted depth. Selected soil material is defined as earth free of organic material and stone larger than 1 ½" in any dimension.

F. Employ a placement method that does not disturb or damage conduit or pipe installed in trench.

G. Maintain optimum moisture content of backfill materials to attain required compaction density. If, in the opinion of Engineer, material available for backfilling is of such character that satisfactory compaction cannot be obtained, Contractor shall provide other suitable material as Engineer may direct. Stone shall be considered unsuitable backfill material if it represents over ten percent of the backfill and is not crushed and graded.

H. Remove surplus backfill materials from site. Contractor is required to monitor and maintain all backfill and any subsidence shall be immediately corrected.

I. Leave fill material stockpile areas completely free of excess fill materials.

3.06 TOLERANCES

A. Sub-grade under roadway areas shall be fine graded and compacted to the exact grade, elevation, and sections required.

B. Top Surface of General Backfilling: Plus or minus one inch from required elevations.

3.07 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Section 01400.

B. Tests and analysis of fill material will be performed in accordance with ANSI/ASTM D698 and with Section 01400.

C. Compaction testing will be performed in accordance with ANSI/ASTM D698 and with Section 01400.

D. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.

E. Frequency of Tests: As directed by Engineer.

3.08 PROTECTION OF FINISHED WORK

A. Re-compact fills subjected to vehicular traffic.

B. Wherever a trench is dug within existing paving of a road or street, and promptly after backfilling thereof, temporary repaving with bituminous material shall be installed and maintained for at least ninety (90) days before a permanent surface is placed. Any sinking of the trench and paving shall be brought to the proper grade by additional bituminous material. The Contractor shall not place material above the proper grade to be pounded down by traffic. Instead he shall thoroughly compact the fill material, using mechanical equipment so that the grade of fill shall level with adjoining pavement. Puddling may be required as directed under supervision of the Engineer. Temporary paving shall consist of a minimum eight-inch (8") stone base with two inches (2") of bituminous material.

3.09 SCHEDULE

A. Water Supply and Sanitary Piping:

1. Bedding Fill: Type 2B, 5 inches thick.

2. Cover with type 2B fill, in 6 inch lifts, compacted to 95 percent to 12 inches above top of pipe and either 2RC or acceptable soil in 6" lifts compacted to 95 percent depending on the location in the remaining trench.

B. Power Ducts:

1. Bedding fill of Type B 6 inches thick, compacted to 90 percent.

2. Remaining fill of Type B, to 6" above conduit compacted to 90 percent.

C. Interior Slab-On-Grade:

1. Type 2B fill, 4 inches thick.

D. Exterior Side of Foundation Walls.

1. Subsoil fill, to subgrade elevation, each lift, compacted to 90 percent.

E. Fill Under Grass Areas:

1. Subsoil fill, to 6 inches below finish grade.

F. Fill Under Concrete Paving:

1. Type 2B fill, to 8 inches below finish paving elevation, compacted to 95 percent.

G. Fill Under Asphalt:

1. Type 2RC fill, to bottom of asphalt, compacted to 95 percent.

H. Fill to Correct Over-excavation:

1. Lean concrete to minimum compressive strength of 1000 psi.

3.10 RESTORATION

A. Roads and Streets

The restoration of road base and surface of State and Township roads shall conform to Penn DOT Form 408 (latest edition) or as directed by the Department of Transportation and or Required in Township Road opening permit.

The Township and/or Department of Transportation may require a concrete cap over all lateral cross trenches in state and township roads.

B. Shoulders – Township Roads

These shoulders shall be backfilled to within six inches (6") of the final grade and thereafter 2RC stone placed and compacted by roller or mechanical tamping. The width of the shoulder shall be considered to be four feet (4') from the edge of cartway unless the existing shoulder exceeds four feet (4') (in which case the shoulder width shall be taken as the width of the existing shoulders). Beyond the shoulder, restoration above the protected pipe or conduit shall consist in replacing, in kind, the existing ground. The Contractor shall re-establish all existing swales and gutters to maintain existing drainage facilities.

If the disturbed or damaged shoulder is of a higher type than as specified above, the work shall be reconstructed and restored to as firm, strong, and durable condition as before the

commencement of the work by Contractor in accordance with the requirements of the Engineer or as provided in the Township road opening permit.

C. Off Road – Developed Areas

Backfill in trenches and around structures shall be brought to within six inches (6") of final grade when same are located in lawns. The final six inches (6") shall be filled with topsoil and seeded as specified in Penn DOT form 408, Section 804, Formula D, or as otherwise directed by the Engineer.

D. Off Road – Undeveloped Areas

Undeveloped areas are defined as meadow and woodland and fields used for planting of crops or to be retained as "open space".

Backfill in fields used for planting crops shall be brought to the level of the bottom of the adjoining topsoil and then filled to adjoining grade with topsoil.

Backfill in meadow and woodlands shall be brought to three inches (3") above final grade and neatly rounded. No large rocks, timbers, or foreign material shall be left on the surface. Seeding will be required as outlined in Item C above.

E. Replacement of Driveways, Curbs, and Sidewalks

Driveways, curbs, and sidewalks that have been removed or damaged shall be replaced in kind to the satisfaction of the property owner. Contractor shall obtain a written release and acceptance from property owner.

F. Clean-up and Repair

Upon completion of the backfilling, the streets or property shall be cleaned and surplus material removed. All surplus material remaining in the public right-of-way shall become the property of the Contractor and shall be disposed of in such manner as he may elect, subject to the approval of the Engineer.

Surplus material excavated from private property shall belong to the Property Owner and shall be disposed of by the Contractor, as required by said Owner.

END OF SECTION

SECTION 02227

COVER MATERIAL PLACEMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This Section covers technical requirements for placement of stone and soil cover material over a geomembrane liner system and anchor trench backfill.

1.02 REFERENCES

A. ASTM D698 "Test Method for Laboratory Compaction Characteristics of Soils Using Standard Effort" (Standard Proctor).

1.03 SUBMITTALS

A. Submit under the provisions of Section 01300.

B. Sieve Analysis: Submit sieve analysis of proposed rip rap.

C. Laboratory Analysis Submit laboratory test results for specified properties of cover soil. Results must be approved by Engineer prior to cover material placement.

1.04 QUALITY CONTROL

A. Testing of materials and inspection of cover material placement shall be performed in accordance with Section 01400.

B. Cover material shall be tested for conformance with specifications. A minimum of one sample shall be taken for sampling when proposed cover material is uniform throughout stockpiles. One additional sample shall be taken of each differing soil type proposed for cover material. Bulk samples shall be taken in the presence of the Engineer and split with Engineer. Contractor shall provide containers for samples to be retained by Engineer.

C. An independent qualified testing agency shall be retained by the Owner to inspect the cover material placement on a full time basis.

1.05 ENVIRONMENTAL CONDITIONS

A. Cover material placement shall not proceed during any precipitation or excessive moisture conditions or in an area of ponded water.

B. Cover material placement shall not proceed when ambient temperature is below 50°F or above 104°F or when the liner temperature is such that large expansion ripples are created unless approved by both Engineer and testing agency.

1.06 PROTECTION

A. Protect benchmarks, existing structures, roads, adjacent pipes, utilities and site features from damage.

B. Protect installed geotextile and geomembrane from damage.

1.07 COORDINATION

A. Coordinate work of this section with geotextile and geomembrane liner installation.

B. Liner and geotextiles must be completely installed, tested and found acceptable for placement of cover material by Owner, testing agency, and Engineer prior to initiation of the work of this section.

C. Coordinate the work of this section with leak testing survey requirements.

PART 2 PRODUCTS

2.01 EMBANKMENT COVER SOIL

A. Excavated material from site, free of topsoil, ice, frozen material, organic material, debris, and roots. Material shall meet the requirements for SW, SP, SW SM, SW-SC, SP SM, SP SC, SM, SC, SC SM or CL as defined by the Unified Soil Classification System (ASTM D2487). Soils shall be well graded with a maximum particle size of 1/2 inch. If necessary to meet size requirement, soil shall be screened. Soil shall be tested for interface friction with the actual geotextile used above the lagoon liner. Interface testing shall be completed with soil at 90% of its maximum dry density as determined by ASTM D698 Standard Proctor and saturated conditions and confining pressures of 1, 2, and 3 psi. One sample shall be taken for interface friction for each type of material proposed for cover soil. In the course of cover soil placement, additional testing may be required if soil type is found to be different than soil originally tested. Results of interface friction tests shall be reviewed by Engineer for acceptability. In general, soil is acceptable if test results fall above a line generated by the following points on a graph:

Cohesion, lbs. (Horizontal axis)	Friction Angle, degrees (Vertical Axis)
0	45
25	25
55	0

B. Borrow material may also be used for cover soil if properties specified above are met. Testing requirements as specified for on site materials shall also apply to borrow material.

2.02 RIP RAP

A. As specified in Section 02275

PART 3 EXECUTION

3.01 BACKFILLING OF ANCHOR TRENCH

A. Anchor trenches shall be adequately drained, to prevent ponding or otherwise softening of the adjacent soils while the trench is open. Also, stormwater shall not be allowed to accumulate in the trenches and flow underneath any completed liner sections. Anchor trenches shall be backfilled in accordance with the construction Drawings.

B. Care shall be taken when backfilling the trenches to prevent any damage to the geotextiles and geomembrane liner.

C. The testing agency and Engineer will observe all backfilling operations and advise the Owner and Installer of any problems.

3.02 LINER COVERING REQUIRMENTS

A. Cover material shall be placed so as to prevent damage to the liner, and in accordance with the details shown on the Drawings. The cover materials shall not be placed until after the liner area has been tested and found acceptable for cover material placement by the testing agency, the Engineer, and Owner.

B. Light ground pressure equipment (less than, 4 psi contact pressure) shall be operated on a minimum of 12 inches of cover. Heavy equipment and trucks shall operate on a minimum of 3 feet of cover. Contractor shall maintain required cover by immediately filling in any ruts or low spots which may develop. Operating equipment over liner shall be minimized. Care shall be taken to avoid sharp turns or any quick starts or stops to prevent punching or shifting the liner. Engineer shall review proposed equipment with Contractor prior to initiation of cover material placement.

C. Frozen material shall not be used as liner cover.

D. The cover material shall be placed so as not to cause any ripples or folds in the geomembrane liner. If ripples or folds are created by expansion of the liner due to temperature, cover material placement shall be scheduled for cooler periods of the day.

E. The liner anchor trenches shall be filled prior to placement of cover.

F. The bottom area of the section being worked shall be covered prior to covering the slopes. The cover material shall not be dumped at the top of the slopes and pulled or pushed down the slopes. A ramp shall be constructed to transport cover material to lagoon bottom. Ramp shall be constructed of material approved by Engineer at sufficient depth (not less than 3 feet) to prevent

damage to underlying geotextiles and geomembrane liner. Contractor shall maintain depth of ramp material and immediately repair any ruts or low spots which may develop.

G. When covering the slopes, the cover material shall be placed up the slope from the bottom.

H. An alternative to pushing the cover material up the slopes is to place it by discharging from a concrete or Gradall bucket with a maximum drop of 2 feet.

I. Cover soil shall be compacted to 90% of the maximum dry density as determined by ASTM D698. Perform compaction using smooth drum vibratory roller with a weight less than 8 tons.

J. Maintain specified 12 inches of compacted cover soil with a maximum deviation of ½ inch.

K. Maintain electrical isolation as required for leak location survey by leaving six inches of bare liner protruding from the back side of the backfilled liner anchor trench.

L. Prior to placement of stone rip rap, leak survey testing shall be completed in accordance with Specification 02227.

M. Stone rip rap shall be placed on lagoon embankments, around inlet and outlet structures, and under aerators in accordance with the Drawings. Contractor shall maintain specified thickness of cover soil and protect geotextiles and geomembrane liner from damage during rip rap placement.

N. The rip rap shall be laid on the finished soil cover. The pieces shall be laid in close contact, and in such a manner that the weight of each piece is carried by the earth, and not by the adjoining pieces. The spaces between the larger pieces shall be filled with spalls, securely fitted into place. The finished work shall present a tight and relatively even surface conforming to the required contour.

O. Any damage to underlying geotextiles and/or geomembrane liner shall be repaired in accordance with Specification 02227. Party causing damage shall be responsible for cost of repairs.

3.03 INSPECTION AND TESTING

A. An independent agency shall be retained by the Owner and will perform field testing and inspection under the provisions of Section 01400.

B. All field inspection and testing shall be performed under the supervision and review of a Professional Engineer licensed in the State of Pennsylvania and employed by the testing agency.

C. Technician performing on site inspection and testing shall have demonstrated experience in cover material placement over geomembrane liner. Qualifications of technician shall be submitted to Engineer for review and approval.

D. The testing agency's responsibilities during cover material placement will include:

1. Laboratory testing of bulk soil samples to determine conformance to specifications, including cohesion and friction angle for various soil types.

2. Confirming that the condition of underlying liner and geotextiles are in compliance with the Contract Documents and the liner manufacturer's recommendations prior to initiation of cover material placement.

3. Full time observation of cover material placement.

4. Overseeing leak location survey.

5. Daily reports of observations and testing activities. Submit to Engineer each day. Reports shall include the following forms

QA/QC 8, Daily QA/QC Report Protective Cover.

E. Testing for cover soil depth shall be performed at a minimum of every 2,500 square feet and at every location of field in place density tests.

F. Field in place density testing shall be performed on compacted cover soil using the nuclear test method (ASTM D 2922) with 6 inch direct transmission. Depth of cover soil shall be checked prior to performing density testing. Extreme care shall be taken to avoid damage to geomembrane liner during testing. The nuclear meter drill rod shall not be driven deeper than 8 inches. A minimum of one test per 2,500 square feet indicating adequate compaction shall be performed. Additional compaction testing may be required by the Engineer to demonstrate adequate compaction.

G. Soil cover material shall be tested for Atterberg limits, Proctor Test, and grain size every 5,000 cubic yards, or whenever the soil type changes.

3.04 PROTECTION OF INSTALLED WORK

A. Protect finished Work.

B. Prevent unauthorized entry to lagoons.

C. Repair any damage caused by erosion.

3.05 INITIAL FILLING

A. Contractor shall fill completed lagoon with clean, uncontaminated water to a depth required to perform initial testing and demonstration of aerators or the depth required to test effluent pumps whichever is deeper.

B. Water shall meet liner manufacturer's recommended quality requirements. Water shall not be muddy or contaminated with chemicals deleterious to wastewater or spray irrigation systems.

C. Contractor shall provide all equipment, labor and water to fill lagoons.

END OF SECTION

QAQC 8

DAILY QA/QC REPORT PROTECTIVE COVER

(Placement of Cover)

(One sheet per day)

PROJECT NAME: Sheeder Tract Wastewater Treatment Plant

PROJECT NUMBER: 59-2.1

DATE: _____

TEMPERATURE BEGINNING: _____

MID DAY: _____

ENDING: _____

CONDITION: Rain Snow Cloudy Sunny

ACTUAL HOURS WORKED:

START: _____

STOP: _____

TYPE OF EQUIPMENT USED FOR HAULING: _____

TYPE OF EQUIPMENT USED FOR SPREADING: _____

CONDITION OF FILL: _____

COMMENTS: _____

_____

DAMAGE TO LINER REPORT: _____

LOCATION: (list location here and on as built):

_____

_____

SIZE: _____

CAUSED BY: _____

REPAIRED BY: _____

TESTED BY:

QA/QC INSPECTOR: _____

SITE SUPERVISOR: _____

SECTION 02228

GEOMEMBRANE LINER

PART I GENERAL

1.01 SECTION INCLUDES

A. This section includes technical requirements for installing the geotextile and geomembranes liner assembly. The geomembrane liner shall be textured (both sides) HDPE (High Density Polyethylene) liners. The geomembrane liner assembly shall be installed in accordance with the Drawings and this Specification.

B. Quality Control requirements including trial seams, seam testing and documentation.

C. Geomembrane liner repairs.

D. Leak testing.

1.02 REFERENCES

A. The latest edition and published addenda of the following publications in effect on the date of the Contract Award are a part of this Section and, where referred to by title or by basic designation only, are applicable to the extent indicated by the specific reference:

B. ASTM Standards

ASTM D 792	Specific Gravity (Relative Density) and Density of Plastics by Displacement
ASTM D 1004	Test Method for Initial Tear Resistance of Plastics Film and Sheeting
ASTM D 1238	Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer
ASTM D 1505	Test Method for Density of Plastics by the Density-Gradient Technique
ASTM D 1603	Test Method for Carbon Black in Olefin Plastics
ASTM D 3895	Test Method for Oxidative Induction Time of Polyolefins by Thermal Analysis
ASTM D 4218	Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique

ASTM D 4833	Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products
ASTM D 5199	Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes
ASTM D 5397	Procedure to Perform a Single Point Notched Constant Tensile Load – (SP-NCTL) Test: Appendix
ASTM D 5596	Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics
ASTM D 5721	Practice for Air-Oven Aging of Polyolefin Geomembranes
ASTM D 5885	Test method for Oxidative Induction Time of Polyolefin Geosynthetics by High Pressure Differential Scanning Calorimetry
ASTM D 5994	Test Method for Measuring the Core Thickness of Textured Geomembranes
ASTM D 6693	Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes

C. Geosynthetic Research Institute Standards

GM10	Specification for the Stress Crack Resistance of Geomembrane Sheet GM13 - 3 of 14 rev. 6 – 6/23/03
GM 11	Accelerated Weathering of Geomembranes using a Fluorescent UVA Condensation Exposure Device
GM 12	Measurement of the Asperity Height of Textured Geomembranes Using a Depth Gage

D. U. S. Environmental Protection Agency Technical Guidance Document "Quality Control Assurance and Quality Control for Waste Containment Facilities," EPA/600/R-93/182, September 1993, 305 pgs.

1.03 GEOMEMBRANE MANUFACTURER REQUIREMENTS

A. The manufacturer of the lining material shall have had at least 2,000,000 square feet of its material installed for linings and shall be approved by the Engineer.

1.04 INSTALLER REQUIREMENTS

A. Installation shall be performed by an Installer that has previously installed a minimum of 2,000,000 square feet of the type of liner to be installed. Evidence of this experience shall be submitted to the Engineer.

B. The Installer shall be approved and/or licensed by the geomembranes manufacturer. Evidence of this qualification shall be submitted to the Engineer.

C. The Installer's or manufacturer's field representative shall be in attendance full time during the geomembrane liner installation.

D. The Installer's or manufacturer's field representative shall certify, in writing, that all material and shop drawings regarding panel placement, seaming locations, and construction techniques are in compliance with the manufacturer's recommendations and other accepted QA/QC procedures and that all field seams are free of defects.

E. The Installer of the lining material shall provide a written acceptance of the prepared subgrade surface to the Owner and Engineer prior to commencing the liner installation. Subsequent repairs to the subgrade and surface shall be the responsibility of the earthwork Contractor.

F. The Installer shall warrant the liner installation for 1 year after acceptance of the liner installation.

1.05 GUARANTEE

A. The manufacturer shall guarantee, in writing, that the liner materials will be free of defects for 20 years after installation is accepted.

B. An installation warranty shall be provided by the Installer for a period of 1 year from the date of acceptance of the liner installation. The warranty shall be written, signed and notarized by the Installer. Receipt of the properly executed warranty is a condition of final acceptance of the liner installation.

1.06 SHIPMENT AND STORAGE REQUIREMENTS

A. All geotextiles and geomembrane liner shall be covered during shipment. Each shipping roll or pallet shall be identified properly with the name of manufacturer / fabricator, product type and thickness, manufacturer batch code, date of manufacture, physical dimensions, panel number, and directions for unfolding.

B. The geotextiles and geomembrane liner shall be stored in accordance with the manufacturer's recommendations in a secured area, away from dirt, dust, water, and extreme heat. The storage space shall be protected from theft, vandalism, animals, passage of vehicles, and are adjacent to the area to be lined. The Contractor shall be responsible for unloading and storing the geotextiles and geomembrane liner.

C. Prior to unloading, the Contractor must ascertain that the equipment to be used to unload or handle the material at the jobsite is adequate and poses no undue risk of injury or damage to person or property. Unloading and handling of the

material must be performed in accordance with the manufacturer's recommendations.

D. The unloading or other handling of the material must be carefully supervised to insure that the material is handled with care and not damaged.

E. Upon arrival at the jobsite, the Installer shall conduct a surface inspection of all rolls or pallets for defects and damage. This inspection shall be conducted without unrolling or unpacking unless defects or damages are found or suspected. The Installer shall notify the Contractor and geomembrane manufacturer of any damage. If damage is believed to have occurred during transit, the carrier who transported the material shall immediately be notified.

1.07 QUALITY CONTROL

A. Manufacturer's Quality Control The liner manufacturer shall have an established quality control and assurance program which is strictly enforced. On request manufacturer shall provide documentation regarding program to Owner and Engineer. Geomembrane manufacturing process shall be monitored on a continual basis. Geomembrane material shall be tested not less than once every 100,000 square feet of finished sheet for tensile properties, carbon black content, thickness and sheet density to demonstrate that the product meets specifications.

B. Inspection and testing of liner installation shall be performed in accordance with Section 01400.

C. Installation Quality Control:

1. The geomembrane Installer shall provide the Owner, independent testing agency, and Engineer with a list of proposed seaming personnel and their professional records. Any proposed seaming personnel deemed insufficiently experienced will not be accepted or will be required to pass a seaming test.

2. The geomembrane Installer shall designate one representative as his Superintendent, who will represent the Installer at all site meetings and be responsible for acting as the Installer's spokesman on site. The Superintendent must have supervised the installation of a minimum of 2,000,000 ft2 of geomembrane, exhibit good management skills, and be fluent in English. The Superintendent shall have training in the following areas: (a) instruction on purpose of lining installation, (b) instructions on placement procedures, and (c) knowledge of safety procedures to be observed during liner handling and placement. His appointment will be approved by the Owner and Engineer.

3. Certain special clothing shall be worn by all on-site personnel during lining placement. This includes:

a. Smooth soled shoes. No shoes with indented patterns shall be worn since rocks can be trapped in the void areas and inadvertently puncture and tear the lining.

b. Gloves when handling/pulling lining into places, gloves should be worn to prevent abrasion or other damage to the worker's hands.

c. Each installer shall be inspected to ensure that his clothing and footwear will not damage either the geomembrane or the installer during placement.

4. Field Panel Identification: The Installer shall label each field panel with an "identification code" (number or letter number) consistent with the layout plan. This identification code will be agreed upon by the Owner, Installer, testing agency, and Engineer. It shall be the responsibility of the Installer to ensure that each field panel placed is marked with the original roll number. The roll number shall be marked at a location agreed upon by the Owner, Installer, testing agency, and Engineer. The testing agency will establish a table or chart showing correspondence between roll numbers and field panel identification codes. The field panel identification code will be used for all Quality Assurance records. The testing agency and Engineer will verify that field panels are installed at the location indicated on the Installer's layout plan, as approved or modified.

5. Field Panel Placement: Form QAQC 5, Daily Panel Placement QA/QC Log, will be completed daily by the testing agency. Installer shall provide information as required to assist in completion of form.

6. Installation Schedule: Field panels shall be placed one at a time unless otherwise approved by the Engineer, and each field panel shall be seamed immediately after its placement (in order to minimize the number of unseamed field panels exposed to wind).

1.08 SUBMITTALS

A. Submit under provisions of Section 01300 of these Specifications.

B. Installation of liner shall not commence until Submittals described in paragraphs C through and including I below have been approved by the Contractor and reviewed and accepted by the Engineer.

C. Panel Layout: Layout drawings shall be submitted which indicate the panel configuration and general location of field seams. Details shall be included to show termination of panels at the perimeter of lined areas, anchoring and methods of sealing around penetration.

D. Geomembrane Installer Information: The geomembrane Installer shall provide the following written information:

1. Evidence of Installer's experience with installation of HDPE liner and qualifications to install liner from specified liner manufacturer.

2. Information on equipment, including seaming apparatus, and personnel, including seaming personnel qualifications.

3. Anticipated daily production.

4. Quality control manual for installation.

5. Name and qualifications of the Superintendent of the Installer's crew.

E. Product Data: Geotextile and geomembrane manufacturers shall provide the following:

1. A properties sheet including, at a minimum, all specified properties, measured using test methods indicated in the Specifications, or equivalent.

2. A list of quantities and descriptions of materials other than the base polymer which comprise the geomembrane.

3. The sampling procedures and results of factory quality control testing.

4. A certification that property values given in the properties sheet are minimum average roll values and are guaranteed by the geotextile or geomembrane manufacturer.

F. Field Testing Procedures: Submit copies of procedures for field testing of seams. Include at a minimum, procedures for peel, shear, air and vacuum testing, plus any other procedures which installer intends to use.

G. Subgrade Surface Acceptance: The Installer shall certify in writing that the surface on which the geotextiles and geomembrane are to be installed is acceptable. Form QAQC 2, Subgrade Surface Acceptance, shall be completed, signed and submitted by the Installer prior to commencement of installation in the area: under consideration. After the subgrade has been accepted by the Installer, it shall be the Installer's responsibility to indicate to the Contractor, testing agency and Engineer any change in the subgrade condition that may require repair work.

H. Manufacturer's Instructions: Provide delivery, storage and installation instructions. Provide liner manufacturer's detailed recommended methods for placement of liner, soil cover over liner, rip rap cover over liner, and construction at penetrations. It shall be the Installer's responsibility to ensure that these criteria are met.

I. Geomembrane Certification: The geomembrane manufacturer shall provide a quality control certificate for each roll of geomembrane provided. The quality control certificate shall be signed by a responsible party employed by the geomembrane manufacturer, such as the production manager. The quality control certificate shall include:

1. Roll numbers and identification.

2. Sampling procedures and results of quality control tests, as minimum, results shall be given for thickness, tensile properties, carbon black content, and density evaluated in accordance with the methods indicated in the Specifications.

J. Installer's Certification At completion of geosynthetic installation, Installer shall provide certification that the geomembrane liner was installed in accordance with the manufacturer's recommendations, the Drawings and Specifications.

K. Leak Survey Firm Information Qualifications of the proposed leak survey firm shall be submitted. Information shall demonstrate that firm has a minimum of 5 years experience in performing similar surveys.

L. Warranty: The Installer shall provide a written, signed, notarized, 1 year warranty on the liner installation.

1.09 ENVIRONMENTAL CONDITIONS

A. Geomembrane placement shall not proceed at an ambient temperature below 50° F or above 104° F. In addition, the geomembranes shall not be unrolled unless the sheet temperatures are between 32° F and 122° F. If ambient conditions create sheet temperatures below 50° F then panels may be warmed by artificial means, prior to seaming; using hot air guns, heat lamps, space heaters, etc., if approved by manufacturer.

B. Geomembrane placement shall not be done during any precipitation or excessive moisture conditions, in an area of ponded water, or in the presence of excessive winds. (e.g. conditions when lining may be blown around; raised off the ground with workers on top of the lining; or causing the liner edges to whip, shred, or rip.)

C. The Installer and testing agency will verify that the supporting soil has not been damaged by weather conditions after subgrade acceptance.

1.10 PRE CONSTRUCTION MEETING

A. A Pre Construction Meeting will be held at the site. As a minimum, the meeting will be attended by the Geosynthetic Installation Superintendent, the independent testing agency, the Engineer, the Earthwork Contractor, and the Owner.

B. Specific topics considered for this meeting include:

1. Review the responsibilities of each party.
2. Review lines of authority and communication.
3. Review methods for documenting and reporting, and for distributing documents and report forms.
4. Establish protocols for testing.
5. Establish protocols for handling deficiencies, repairs, and retesting. .
6. Review the time schedule for all operations.
7. Establish rules for writing on the geomembrane, i.e., who is authorized to write, type of writing materials, what can be written, and in which color.
8. Outline procedures for packaging and storing archive samples.
9. Review panel layout and numbering systems for panels and seams.
10. Establish procedures for use of the extrusion seaming apparatus, if applicable.
11. Establish procedures for use of the fusion seaming apparatus, if applicable.
12. Establish procedures for the chemical bonding process, if applicable.
13. Finalize field cutout samples sizes.
14. Review seam testing procedures.
15. Review repair procedures.
16. Conduct a site walk around to verify that construction is proceeding on schedule, and to review material storage locations.
17. Establish soil stockpiling locations, if applicable.

C. The meeting will be documented by a person designated at the beginning of the meeting, and minutes will be transmitted to all parties.

1.11 COORDINATION

A. Coordinate liner installation with work of other sections.

B. Ensure each lagoon subgrade is entirely completed and inspected by Installer before commencement of liner installation of that lagoon.

C. Schedule delivery of concrete anchor strips sufficiently in advance to allow concrete to be poured and cured prior to installation of geomembrane liner.

D. Coordinate work to minimize length of time installed liner is left exposed.

E. Coordinate seam testing requirements with liner, geotextile and cover material placement. Arrange with testing laboratories to provide test results within 24 hours.

PART 2 PRODUCTS

2.01 GEOTEXTILES

A. Geotextiles shall be of polypropylene nonwoven, continuous filament, needle punched geotextile.

B. All geotextiles shall consist of continuous polymeric filaments composed of polypropylene fibers. The fibers shall be oriented into a stable network whereby they retain their positions relative to each other. The geotextile shall be mildew, insect, and rodent resistant and inert to chemicals commonly found in soils.

C. The geotextiles shall conform to the following requirements:

PROPERTY	TEST METHOD	MINIMUM AVERAGE ROLL VALUE
Grab Tensile Strength, lb	ASTM D 4632	320
Grab Elongation, %	ASTM D 4632	50
Puncture Strength, lb	ASTM D 4833	210
Mullen Burst, psi	ASTM D 3786	620
Trapezoidal Tear, lbs	ASTM D 4533	125
Weight, oz/s d (nominal)		12
Ultraviolet Resistance, %	ASTM D 4355	70
Retention at 500 hours		

D. The geotextiles shall be Geotex 1291 by Synthetic Industries, Inc. or approved equal.

2.02 GEOGRID

A. The structural geogrid shall be an integrally formed grid structure manufactured of a stress resistant polypropylene material with molecular weight and molecular characteristics which impart:

1. High resistance to loss of load capacity or structural integrity when the geogrid is subjected to mechanical stress in installation;

2. High resistance to deformation when the geogrid is subjected to applied force in use; and

3. High resistance to loss of load capacity or structural integrity when the geogrid is subjected to long-term environmental stress.

B. The structural geogrid shall accept applied force in use by positive mechanical interlock (i.e. by direct mechanical keying) with:

1. Compacted soil or construction fill materials;

2. Contiguous sections of itself when overlapped and embedded in compacted soil or construction fill materials; and

3. Rigid mechanical connectors such as bodkins, pins or hooks.

C. The structural geogrid shall possess sufficient flexural stiffness to enable efficient installation over weak or wet in situ soils and sufficient torsional stiffness to resist in-plane movement of compacted soil or construction fill materials when these are subject to rotating lateral displacement forces such (i.e. what a moving vehicle causes in a roadway foundation).

D. The structural geogrid shall possess complete continuity of all properties throughout its structure and shall be suitable for internal reinforcement of compacted soil or particulate construction fill materials to improve their load bearing capacity in structural load bearing applications such as foundation improvement systems.

E. The structural geogrid shall have a minimum ultimate strength of 1,300 lb/ft in both the machine and cross-machine directions.

F. The Geogrid shall be Structural Geogrid BX1200 as manufactured by: Tensar Earth Technologies, Inc., 5883 Glenridge Drive, Suite 200, Atlanta, Georgia 30328-5363, (800) 836-7271 or approved equal.

2.02 GEOMEMBRANE LINER

A. Liner compound shall be specifically designed for buried and for hydraulic liner installations and be chemically compatible with the anticipated water. The liner shall have been demonstrated by prior use to be suitable and durable for such purposes.

B. The liner shall be obtained from an approved liner manufacturer that has shown its liner to be compatible with any site-specific stability problems and durability criteria, which may be identified.

C. The liner shall be produced so as to be free of holes, undispersed raw materials, blisters, or any sign of delamination. Any such defect shall be repaired in accordance with the manufacturer's recommendations.

D. The lining material shall be uniform in color, thickness, size, and surface texture.

E. The liner accessories shall be obtained from manufacturers whom have shown their materials to be compatible with the site-specific stability problems, and durability criteria, as well as chemically compatible with anticipated water.

F. Prior to geomembrane liner installation, the manufacturer shall provide material certification that its liner meets the physical and chemical requirements specified herein.

G. The liner shall consist of a 60 mil textured HDPE liner for all areas shown on the Drawings.

H. The HDPE lining material shall be manufactured with a minimum 22.0 feet seamless width. There shall be no factory seams.

I. Material Classification and Formulation

1. This specification covers high density polyethylene geomembranes with a formulated sheet density of 0.940 g/ml, or higher. Density can be measured by ASTM D1505 or ASTM D792. If the latter, Method B is recommended.

2. The polyethylene resin from which the geomembrane is made will generally be in the density range of 0.932 g/ml or higher, and have a melt index value per ASTM D1238 of less than 1.0 g/10 min.

3. The resin shall be virgin material with no more than 10% rework. If rework is used, it must be a similar HDPE as the parent material.

J. Physical, Mechanical and Chemical Property Requirements

1. The geomembrane shall conform to the test property requirements prescribed in the following table

2. The values listed in the tables of this specification are to be interpreted according to the designated test method. In this respect they are neither minimum average roll values (MARV) nor maximum average roll values (MaxARV).

3. The properties of the HDPE geomembrane shall be tested at the minimum frequencies shown. If the specific manufacturer's quality control guide is more stringent and is certified accordingly, it must be followed in like manner.:

Property	Test Method	Minimum Average Values	Testing Frequency (minimum)
Thickness, mils			Per roll
minimum average	ASTM D 5994	57	
lowest individual of 8 of 10 readings		54	
lowest individual of 10 readings		51	
Asperity Height, mils	GRI GM12	10	Every 2nd roll
Sheet Density, g/cc	ASTM D 1505/ D 792	.940	200,000 lb
Tensile Properties [1]	ASTM D 638 (Type IV Specimen @ 2 in/ min)		20,000 lb
1. Yield Strength, lb/ in		126	
2. Break Strength, lb/ in		90	
3. Yield Elongation, %		12	
4. Break Elongation, %		100	
Tear Resistance, lb	ASTM D 1004	42	45,000 lb
Puncture Resistance, lb	ASTM D 4833	90	45,000 lb
Stress Crack Resistance [2], hrs	ASTM D 5397 (App.)	200	Per GRI GM10
Carbon Black Content [3], %	ASTM D 1603	2.0-3.0	20,000 lb
Carbon Black Dispersion [4]	ASTM D 5596	Note 4	45,000 lb
Oxidate Induction Time (OIT)Standard OIT, minutes	ASTM D 3895	100	200,000 lb
Oven Aging at 85°C	ASTM D 5721		
Standard OIT (% retained after 90 days)	ASTM D 3895	55	Per each formulation
UV Resistance [5]	GRI GM11		

Property	Test Method	Minimum Average Values	Testing Frequency (minimum)
High Pressure OIT [6] (% retained after 1600 hrs)	ASTM D 5885	50	Per each formulation

Notes

1. Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction.

   Yield elongation is calculated using a gauge length of 1.3 inches; Break elongation is calculated using a gauge length of 2.0 inches.

2. The yield stress used to calculate the applied load for the SP-NCTL test should be the mean value via MQC testing.

3. Other methods such as ASTM D 4218 or microwave methods are acceptable if an appropriate correlation can be established.

4. Carbon black dispersion for 10 different views: All 10 in Categories 1 and 2.

5. The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation 60°C.

6. UV resistance is based on percent retained value regardless of the original HP-OIT value.

M. The field seams shall meet the following requirements:

Property	Test Method	Minimum Average Values
Thickness	ASTM D5199	60
Shear Strength (lb/in)	ASTM D 6392	120
Peel Strength (lb/in)	ASTM D 6392	88 & FTB

N. Workmanship and Appearance

1. Textured geomembrane shall generally have uniform texturing appearance. It shall be free from agglomerated texturing material and

such defects that would affect the specified properties of the geomembrane.

2. General manufacturing procedures shall be performed in accordance with the manufacturer's internal quality control guide and/or documents.

O. MQC Sampling

1. Manufacturing Quality Control (MQC) - A planned system of inspections that is used to directly monitor and control the manufacture of a material, which is factory, originated. MQC is normally performed by the manufacturer of geosynthetic materials and is necessary to ensure minimum (or maximum) specified values in the manufactured product. MQC refers to measures taken by the manufacturer to determine compliance with the requirements for materials and workmanship as stated in certification documents and contract specifications. ref. EPA/600/R-93/182

2. Manufacturing Quality Assurance (MQA) - A planned system of activities that provides assurance that the materials were constructed as specified in the certification documents and contract specifications. MQA includes manufacturing facility inspections, verifications, audits and evaluation of the raw materials (resins and additives) and geosynthetic products to assess the quality of the manufactured materials. MQA refers to measures taken by the MQA organization to determine if the manufacturer is in compliance with the product certification and contract specifications for the project. ref. EPA/600/R-93/182

3. Formulation, n - The mixture of a unique combination of ingredients identified by type, properties and quantity. For HDPE polyethylene geomembranes, a formulation is defined as the exact percentages and types of resin(s), additives and carbon black.

4. Sampling shall be in accordance with the specific test methods listed in paragraph J. If no sampling protocol is stipulated in the particular test method, then test specimens shall be taken evenly spaced across the entire roll width.

5. The number of tests shall be in accordance with the appropriate test methods listed in paragraph J.

6. The average of the test results should be calculated per the particular standard cited and compared to the minimum value listed in these tables, hence the values listed are the minimum average values and are designated as "min. ave."

P. MQC Retest and Rejection

1. If the results of any test do not conform to the requirements of this specification, retesting to determine conformance or rejection should be done in accordance with the manufacturing protocol as set forth in the manufacturer's quality manual.

Q. The HDPE liner manufacturer shall be listed by the Geosynthetic Institute (GSI), 475 Kedron Avenue, Folsom, PA 19033-1208 USA.

R. The liner shall be HDPE Grip Liner as manufactured by: Agru America's, Inc. 700 Rockmead, Suite 150, Kingwood, Texas 77339 USA or approved equal.

2.03 ACCESSORIES

A. Seal Lock Furnish and install extruded polyethylene concrete embedment anchors. Anchor material shall be compatible with specified liner material and allow water tight extrusion weld with specified liner. Anchors shall be as recommended by liner manufacturer.

B. Vent Furnish and install vents in liner as shown on the Drawings. Vent material shall be compatible with specified liner material and allow watertight extrusion weld with specified liner. Vents shall be as recommended by liner manufacturer.

C. Miscellaneous Materials Miscellaneous materials such as neoprene gaskets or stainless steel bands shall be recommended by the liner manufacturer.

2.04 CAULK

A. Caulk shall be Sikaflex IA, as manufactured by Sika Corporation, or approved equivalent.

PART 3 EXECUTION

3.01 SUBGRADE CONDITIONS

A. No geotextiles or geomembrane shall be installed until subgrade conditions are acceptable.

B. PROOFROLLING: The rolling must be conducted using 20 passes of a 20-ton (static weight), sheepsfoot roller operated in vibratory mode. It is important to point out that the proofrolling might actually induce some near surface instability in clayey soils but is critical to verifying a sound bottom. Following the proofrolling, the surface may need to be scarified, aerated and re-compacted using a conventional 10-ton roller. The proofrolling shall be witnessed and subgrade approved by the OWNERS Geotechnical Engineer.

C. The Installer shall certify in writing that the surface on which the geogrid, geotextiles and geomembrane are to be installed is acceptable.

3.02 ANCHOR TRENCH EXCAVATION

A. Anchor trenches shall be excavated to width and depth dimensions as shown on Drawings prior to geotextile and geomembrane placement.

B. Excavation of anchor trench shall be performed using equipment which minimizes damage to exposed geotextile and geosynthetic clay liner.

C. Slightly round corners shall be provided in trenches where geomembrane adjoins the trench so as to avoid sharp bends in the geomembrane.

D. All loose fill shall be removed from trench excavation prior to placement of liner. No loose soil shall underlie the geotextiles or geomembranes in the trenches.

E. Bottom of anchor trench shall be firm compacted soil, free of any water.

3.03 PLACEMENT OF GEOGRID

A. Geogrid shall be placed in accordance with the manufactures recommendations.

B. The subgrade on which the geogrid is to be placed shall be in a smooth condition free of obstructions, depressions, debris, and soft or low density pockets of material.

C. Place geogrid in position, cut the roll bands, and manually unroll it over the prepared surface.

D. Overlap adjacent rolls along sides and ends in accordance with manufactures recommendations.

E. Adjacent geogrid rolls are not normally connected to one another; however nylon cable ties can be effective in helping maintain overlap dimensions. These ties are not considered structural connections, rather construction aides.

F. Cut and overlap geogrid to accommodate curves. Cutting may be done with sharp shears or knife-like implement; however, hand-held power saws are permitted.

G. Cut grid to conform to immovable protrusions.

H. Place geogrids in daily work sections so that proper alignment is maintained.

3.04 PLACEMENT OF GEOTEXTILES

A. Geotextiles shall be placed as in accordance with PennDOT Pub. 408, Section 212, except as modified herein.

B. The subgrade on which the geotextile is to be placed shall be in a smooth condition free of obstructions, depressions, debris, and soft or low density pockets of material.

C. The geotextile shall be placed with the long dimension parallel with the slope direction (up and down the slope), where applicable.

D. On slopes, the geotextiles shall be secured in the anchor trench and then rolled down the slope in such a manner as to continually keep the geotextile sheet in sufficient tension to preclude folds and wrinkles.

E. In the presence of wind, all geotextiles shall be weighted with sandbags or the equivalent.

F. Geotextiles shall be cut using an approved cutter. If the material is being cut in place, special care must be taken to protect other geosynthetic materials from damage.

G. Care shall be taken not to entrap stones or excessive dust that could damage the geomembrane, or generate clogging of drains or filters.

H. The geotextile shall be laid smooth and free of tension, stress, folds, wrinkles, or creases.

I. The adjacent sheets of geotextile shall be sewn together the entire length of the seam with a single lock type stitch seam (factory stitch) or a double chain type stitch seam (field stitch). Geotextiles shall be overlapped a minimum of four (4) inches prior to sewing.

J. The sewn seam breaking strength shall be a minimum of 270 pounds as measured by ASTM D4632.

K. The geotextile shall be protected at all times during the construction from contamination resulting from surface runoff. Any fabric so contaminated or otherwise damaged shall be removed and replaced.

L. Placement of geotextile over geomembrane liner shall be performed using methods to prevent damage to liner. Any damaged liner shall be replaced or repaired in accordance with manufacturer's recommendations and as approved by Engineer.

M. Backfilling operations shall be performed in a manner, which prevents damage to the geotextile. Any geotextiles damaged during backfilling operations shall be replaced or repaired in accordance with manufacturer's recommendations and as approved by Engineer.

N. If approved by testing agency and Engineer, any holes or tears in the geotextiles on slopes may be repaired by making a patch from the same geotextile and seaming it into place with a minimum of twelve inches (12") overlap in all directions. Should any tear exceed 10% of the width of the roll, that roll shall be removed from the slope and replaced.

O. If approved by testing agency and Engineer, any holes or tears in the geotextiles on horizontal areas may be repaired by making a patch from the same geotextile and spot seaming it place with a minimum of twelve inches (12") overlap in all directions.

3.05 GENERAL REQUIREMENTS GEOMEMBRANE LINER INSTALLATION

A. The Installer shall be responsible for the design of the geomembrane liner panel layout. Panels shall be placed with the seams running up and down the slopes, not horizontally. Horizontal seams shall be more than 5 feet from the toe of slope and not in areas of potential stress concentrations unless otherwise approved by Engineer.

B. The Installer shall prepare shop drawings with a proposed panel layout to cover the area shown on the Drawings. These shop drawings shall be submitted for approval prior to delivery of the liner as described in Paragraph 1.08 above.

C. The Installer, testing agency, Engineer and the Contractor shall inspect the entire prepared surface underlying the geomembrane immediately prior to installation of the liner assembly. The Installer shall submit to the Owner in writing, prior to commencement of the liner installation, acceptance of the subbase preparation. The geosynthetic elements immediately underlying the geomembrane shall be clean and free from debris.

D. The Installer shall verify the method and equipment used to unroll the panels does not cause scratches or crimps in the geomembrane and does not damage the supporting soil.

E. The Installer shall verify the method used to place the panels minimizes wrinkles (especially differential wrinkles between adjacent panels). The panels are installed in a relaxed condition, free of tension, stress, folds or bends, and not stretched to fit.

F. The Installer shall verify that adequate temporary loading and/or anchoring (e.g., sand bags, tires), not likely to damage the geomembrane, is placed to prevent uplift by wind (in case of high winds, continuous loading by adjacent sand bags is recommended along the edges.)

G. The Installer shall ensure that direct contact with the geomembrane is minimized; i.e., the geomembrane is protected by geotextiles, extra geomembrane, or other suitable materials, in areas where excessive traffic may be expected. Materials, equipment and other items shall not be dragged, allowed to slide, or allowed to impact the geomembrane or other liner system components.

3.06 GEOMEMBRANE INSTALLATION

A. The geomembrane liner shall be placed over the prepared surface to be lined in such a manner as to insure minimum handling and shall be installed in accordance with the manufacturer's recommendations. The prepared subgrade shall be maintained in a smooth, uniform, and compacted condition during installation.

B. The liner shall be installed in a relaxed condition and shall be free of tension and stress upon completion of the installation. The liner shall not be stretched to fit. The liner shall be spread out so there are no folds or bends in the liner.

C. Materials, equipment, or other items shall not be dragged across the surface of the liner or be allowed to slide down slopes on the liner. No vehicles of any type shall be operated directly on the geomembrane liner. Personnel walking upon the lining material shall wear soft sole shoes. Any portion of the liner damaged during installation by any cause shall be removed or repaired by using an additional piece of liner.

D. The amount of liner placed shall be limited to that which can be seamed in one day.

E. Panels shall be placed one at a time unless otherwise approved by the Engineer and each field panel shall be seamed immediately after its placement (in order to minimize the number of unseamed field panels exposed to wind).

F. It is usually beneficial to "shingle" overlaps in the downward direction to facilitate drainage in the event of precipitation. It is also beneficial to proceed in the direction of prevailing winds. Scheduling decisions must be made during installation, in accordance with varying conditions. In any event, the Installer shall be fully responsible for the decisions made regarding placement procedures.

G. The Engineer and testing agency will evaluate changes in the schedule proposed by the Installer.

H. Repair of damaged liner panels and test strip removal areas shall conform to the manufacturer's recommendations. Any tear, puncture, obvious stress point, seam failure, or hole created by sampling or testing procedures shall be overlaid with liner material of the same type used for liner panel fabrication and seamed as specified herein. No loose panel edges, bubbles, or wrinkles will be permitted in the patches. All patches shall be tested as specified herein.

I. The Installer and Contractor shall use construction equipment that does not damage or severely stress the liner. It is the Owner's, Engineer's and/or testing agency's option to have areas suspected of having undergone liner damage or distress exposed for visual inspection and testing. Any necessary repair work and cost of exposing the liner for inspection will be performed at the expense of

the party causing the damage. The Owner, Engineer or testing agency also has the option to reject any equipment that creates damage or distress to the liner by its normal operation and have it removed from the work area.

J. The Installer, Engineer and testing agency will visually observe every panel, after placement and prior to seaming, for damage. Any tear, punctures, holes, thin spots, etc. are either marked for repair or the panel is rejected. Damaged panels or portions of damaged panels which have been rejected will be marked and their removal from the work area recorded by the testing agency's technician. Repairs will be made according to the manufacturer's recommended procedures and this Specification.

3.07 TRIAL SEAMS

A. Trial seams shall be made on fragment pieces of geomembrane liner to verify that seaming conditions are adequate. Such trial seams shall be made at the beginning of each seaming period, and at least once every five hours, and at the end of the day for each seaming apparatus used in the seaming period. A trial seam also shall be made in the event that the ambient temperature varies more than 18° F since the last passing trial seam. The ambient temperature shall be measured 6 in. above the liner. Also, each seamer or seamer crew shall make at least one trial seam each seaming period, or each 1,000 feet of seam. Trial seams shall be made under the same conditions as actual seams. If any seaming apparatus is turned off for any reason, a new passing trial seam shall be completed for that specific seaming apparatus. The Installer shall provide the tensiometer required for shear and peel testing in the field. The tensiometer shall be automatic and shall have a direct digital readout.

B. The trial seam sample for polyethylene shall be at least 3 ft. long by 1 ft. (after seaming) with the seam centered lengthwise.

C. All sample seams shall be cured or aged properly before testing in accordance with the test procedure.

D. Four specimens of field seams for HDPE geomembranes shall initially be taken by the Installer and tested. Two specimens shall be tested in shear and two in peel using a field tensiometer, and they should not fail in the seam. Minimum strength requirements for field seams are provided on in Paragraph 2.03 K above. In each type of test, a maximum of one non FTB failure out of five tests is acceptable provided that the strength requirement is met on that sample. If a specimen fails, the entire operation shall be repeated. If the additional specimen fails, the seaming apparatus and seamer will not be accepted and will not be used for seaming until the deficiencies are corrected and two consecutive successful full trial seams are achieved.

E. The Engineer and testing agency will observe all trial seam procedures and record data on Form QA/QC 7, Field Seam samples. Installer shall assist in providing information for completion of form. The remainder of the successful trial seam sample will be assigned a number and marked accordingly by the TESTING AGENCY'S technician, who will also log the date, hour, ambient temperature, number of seaming unit, name of seamer, and pass or fail description. The sample itself will be cut into two pieces, one to be retained in the Owner's archives and one to be given to the Installer.

3.08 GEOMEMBRANE FIELD SEAMING

A. In general, seams should be oriented parallel to the line of maximum slope, i.e., oriented along, not across, the slope. In corners and odd shaped geometric locations, the number of seams should be minimized. No horizontal seam should be less than 5 ft. from the toe of slopes, or areas of potential stress concentrations, unless otherwise authorized.

B. Prior to seaming a lining sheet or patch, all edges shall be free of defects such as blisters and tears. Once the seam is formed, it is desirable that there be no free edge on the upper lining that equipment or other items can catch or snag on, potentially damaging the seam in this location.

C. Sandbags shall remain placed on the seaming edges of all sheets until the lining is formally seamed. Sandbags shall be spaced no more than 5 to 6 feet apart.

D. If seaming operations are carried out at night, adequate illumination shall be provided.

E. Seaming shall extend to the outside edge of panels in the anchor trench. No liner edge shall be buried in the anchor trench within 30 feet of an "incomplete" field seam. This allows for re tensioning removing wrinkles along the seam area.

F. Approved processes for field seaming of polyethylene are extrusion seaming and fusion seaming. Proposed alternate processes shall be documented and submitted to the Engineer for approval. Only apparatus which have been specifically approved by make and model shall be used. The Installer shall use a pyrometer to ensure that accurate temperatures are being achieved.

G. Extrusion Process: For extrusion welding all sheeting shall be welded together by means of integration of the extrudate bead with the lining material. The composition of the extrudate shall be identical to the lining material, or all sheeting shall be welded together using the hot wedge welding assembly. The extrusion seaming apparatus shall be equipped with gauges giving the relevant temperatures of the apparatus such as the temperatures of the extrudate, nozzle, and preheat. The Installer shall provide documentation regarding the extrudate to the Engineer and shall certify that the extrudate is comprised of the same resin as the geomembrane sheeting: The Installer shall:

1. Long apparatus temperatures, extrudate temperatures, and ambient temperatures at appropriate intervals. Ambient temperatures will be measured 6 in. above the geomembrane surface.

2. Maintain on site spare operable seaming apparatus.

3. Ensure the extruder is purged prior to beginning a seam until all heat degraded extrudate has been removed from the barrel.

4. Ensure the electric generator is placed on a smooth base such that no damage occurs to the geomembrane.

5. Ensure a smooth insulating plate or fabric is placed beneath the hot seaming apparatus after usage.

H. Fusion Process: The double fusion weld shall be the primary method of seaming. The fusion seaming apparatus shall be an automated devise that heats the geomembrane edge, squeezes the two layers, and fuses the seam together. The fusion seaming apparatus shall be equipped with gauges giving the applicable temperatures in the zone of contact where the machine is actually fusing the liner material. Pressure settings shall be verified by the Installer prior to each seaming period. The Installer shall:

1. Log ambient temperatures, seaming apparatus temperatures, and speeds. Ambient temperatures will be measured 6 in. above the geomembrane surface.

2. Maintains on site spare operable seaming apparatus.

3. Ensure the edge of the cross seam is ground to a smooth incline (top and bottom) prior to seaming of cross seams.

4. Ensure the electric generator is placed on a smooth base such that no damage occurs to the geomembrane.

5. Ensure a smooth insulating plate or fabric is placed beneath the hot seaming apparatus after usage.

6. Ensure build up of moisture between the sheets is prevented.

I. If seam overlap grinding is required, the process shall be completed according to the geomembrane manufacturer's instructions within one hour of the seaming operation, and in a way that does not damage the geomembrane. The abrading shall not extend beyond the extrusion seam.

J. Overlapping and Temporary Bonding: The panels of polyethylene (HDPE) geomembrane have a minimum finished overlap of 4 in. for extrusion and fusion seaming, but in any event sufficient overlap shall be provided to allow peel tests to be performed on the seam. No solvent or adhesive shall be used unless the product is accepted in writing by the Engineer. The procedure used to

temporarily bond adjacent panels together shall not damage the geomembrane (in particular, the temperature of hot air at the nozzle of any spot seaming apparatus is controlled such that the geomembrane is not damaged). The Installer will log all overlapping and temporary bonding and report any non compliance.

K. Seam area of panels shall be wiped clean to remove all dirt, moisture, grease or other foreign material in accordance with the manufacturer's requirements.

L. Cold weather installation and seaming shall be performed in accordance with the material manufacturer's requirements.

M. Liner attachment to concrete structures shall be in accordance with the Drawings.

N. No field seam shall be covered or buried until tested and accepted by the Engineer. Concrete attachments and liner penetration attachments shall not be covered until inspected and accepted by the testing agency and Engineer.

O. The shear strengthened peel adhesion for field seams shall meet the strengths specified herein. The seam failure shall be by Film Tear Bond (FTB) type.

P. The completed liner shall not exhibit "trampolining" during daylight hours.

Q. No "fish mouths" shall be allowed within the seam area. Where "fish mouths" do occur, the material shall be cut, lapped, seamed together in the lapped area, and patched with an oval or round patch extending a minimum of 6" beyond the cut in all directions in accordance with the manufacturer's requirements.

3.09 NONDESTRUCTIVE SEAM TESTING REQUIREMENTS

A. Upon completion of the liner installation and prior to placement of cover material, the Installer's Superintendent or quality control technician, in the presence of the Owner, Engineer, and testing agency, shall fully inspect and perform nondestructive testing on every linear foot of field seam. Any area showing a defect shall be marked and repaired in accordance with applicable type of liner material repair procedures.

B. The Installer shall employ on site physical non destructive testing on all welds. Fillet extrusion welds shall be tested with a vacuum chamber. Hot wedge welds shall be pressure tested, pressurizing the gap created by the split face design of the wedge. Procedures and test pressures for non destructive testing shall be as recommended in liner manufacturer's "Construction Quality Control Manual". Copies of procedures shall be submitted by Installer in accordance with Paragraph 1.08 above prior to installation of the liner. Probe test methods shall not be used.

C. The purpose of the non destructive tests is to check the continuity of seams. It does not provide information on seam strength. Continuity testing shall be

carried out as the seaming work progresses, not at the completion of all field seaming. Non destructive testing shall not be permitted before sunrise or after sunset unless Installer demonstrates capabilities to do so.

D. If approved by the Engineer, the Installer shall use the following procedures at locations where seams cannot be non destructively tested:

1. All such seams shall be cap stripped with the same geomembrane.

2. If the seam is accessible to testing equipment prior to final installation, the seam shall be non destructively tested prior to final installation.

3. If the seam cannot be tested prior to final installation, the seaming and cap stripping operations shall be observed by the Engineer and Installer for uniformity and completeness.

E. The Installer shall complete any required repairs in accordance with Paragraph 3.10 below. The Engineer, Installer's Superintendent, and testing agency technician shall:

1. Observe the repair and retesting of the repair.

2. Mark on the geomembrane that the repair has been made.

3. Document the results.

3.10 DESTRUCTIVE SEAM TESTING REQUIREMENTS

A. Destructive seam tests will be performed at locations selected by the Engineer. The purpose of these tests is to evaluate seam strength. Seam strength testing will be done as the seaming work progresses, not at the completion of all field seaming. Care will be taken to properly cure all seams and samples according to test procedure requirements.

B. All holes in the geomembrane resulting from destructive seam sampling shall be immediately repaired. The continuity of the new seams in the repaired area shall be tested.

C. Location and Frequency: The Engineer will select locations where seam samples will be cut out for laboratory testing. The Installer will not be informed in advance of the locations where the seam samples will be taken. Those locations will be established as follows:

1. A minimum frequency of one test location per 500 ft. of seam length.

2. A maximum frequency will be agreed upon by the Installer, Owner, and Engineer at the Pre Construction Meeting.

3. Test locations will be determined during seaming at the Engineer's discretion.

D. Sampling Procedure: Samples shall be cut by the Installer as the seaming progresses in order to have laboratory test results before the geomembrane is covered by another material. The testing agency technician will:

1. Observe sample cutting.
2. Assign a number to each sample, and mark it accordingly.
3. Record the sample location on the layout drawing.
4. Record the reason for taking the sample at this location (e.g., statistical routine, suspicious feature of the geomembrane).

E. Size of Samples: At a given sampling location, two types of samples shall be taken by the Installer:

1. Samples for field testing and
2. Samples for laboratory testing.

The specimen sizes may be changed at the advice or recommendation of the Engineer and final determination of the sample sizes will be made at the Pre Construction Meeting.

F. Field Testing: First, two specimens for field testing shall be taken. Each of these specimens shall be 1 in. wide by 12 in. long, with the seam centered parallel to the 1 in. width side. The distance between these two specimens shall be 42 in. If both specimens pass the field test, a sample for laboratory testing shall be taken as described below. The two 1 in. wide specimens will be tested in the field, by tensiometer, for peel and shear respectively. Copies of procedures for peel and shear testing shall be submitted by Installer in accordance with Paragraph 1.08 above prior to installation of the liner. The Engineer and testing agency will witness all field tests and mark all samples with their number. The testing agency will log the date and time, ambient temperature, number of seaming unit, name of technician, apparatus temperatures and speeds, and pass or fail description. If any field test sample fails to pass, the procedures outlined below shall be followed for repair of the seam.

G. Laboratory Testing Samples: If both field tests pass, a laboratory sample shall be taken. The sample for laboratory testing shall be located between the two specimens for field testing. The destructive sample shall be 12 in wide by 42 in. long with the seam centered lengthwise. The sample shall be cut into three parts and distributed as follows:

1. One portion to the Installer for laboratory testing, 12 in. x 12 in.
2. One portion to the Owner for archive storage, 12 in. x 12 in.
3. One portion for Geosynthetics CQA Laboratory testing, 12 in. x 18 in.

H. Geosynthetics Construction Quality Assurance Laboratory Testing: Destructive test samples will be packaged and shipped, if necessary, under the responsibility of the testing agency in a manner that will not damage the test sample. The Owner will be responsible for storing the archive samples. Testing of polyethylene materials will include "Seam Strength" (ASTM D 4437 using 1" strips and a strain rate approved by the Engineer and testing agency) and "Peel Adhesion" (ASTM D 4437 as modified in NSF Appendix A and using 1" strips and a strain rate approved by the Engineer and testing agency). At least 5 specimens will be tested for each test method. A maximum of one non FTB failure is acceptable provided that strength requirements are met on that sample. The Geosynthetics CQA Laboratory shall be accredited by the Geosynthetics Accreditation Institute Lab Accreditation Program (GAI/LAP) and shall provide test results no more than 24 hours after they receive the samples. The Engineer will review laboratory test results as soon as they become available, and make appropriate recommendations to the Owner.

I. Installer's Laboratory Testing: The Installer's laboratory shall be GAI LAP accredited and shall present test results to the Owner, testing agency and the Engineer for review.

J. Procedures for Destructive Test Failure: The following procedures will apply whenever a sample fails a destructive test, whether that test is conducted by the Geosynthetics CQS Laboratory, the Installer's Laboratory, or by field tensiometer. The Installer has two options listed below as 1 and 2. The testing agency will document all actions taken in conjunction with destructive test failures.

1. The Installer can reconstruct the seam between any two passed destructive seam test locations.

2. The Installer can trace the seaming path to an intermediate location (at 10 ft. minimum from the point of the failed test in each direction) and take a small sample for an additional field test at each location. If these additional samples pass tensiometer testing, then full destructive laboratory samples shall be taken. If these destructive laboratory samples pass the tests, then the seam shall be reconstructed between these locations by capping. If either sample fails, then the process is repeated to establish the zone in which the seam shall be reconstructed. If a fusion type seam fails destructive testing and the Installer chooses to cap the seam, the only acceptable capping method is as described below. Applying topping is not an approved method of capping long lengths of seam.

3. All acceptable seams shall be bounded by two locations from which destructive samples passing laboratory tests have been taken. In cases exceeding 150 ft. of reconstructed seam, a sample shall be taken from

the zone in which the seam has been reconstructed. This sample must pass destructive testing or the procedure outlined in this section shall be repeated.

3.11 DEFECTS AND REPAIRS

A. Identification: All seam and non seam areas of the geomembrane will be examined by the testing agency and Engineer for identification of defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. Because light reflected by the geomembrane helps to detect defects, the surface of the geomembrane shall be clean at the time of the examination. The geomembrane surface shall be broomed or washed by the Installer if the amount of dust or mud inhibits examination. Water used for washing shall be directed to a sedimentation control structure prior to discharge.

B. Evaluation: Each suspect location both in seam and non seam areas will be non-destructively tested using the methods described in Paragraph 3.09 as appropriate. Each location which fails the non destructive testing will be marked by the testing agency and repaired by the Installer. Work shall not proceed with any materials, which will cover locations which have been repaired until laboratory test results with passing values are available.

C. Repair Procedure: Any portion of the geomembrane exhibiting a flaw, or failing a destructive or non destructive test, shall be repaired. Several procedures exist for the repair of these areas. The final decision as to the appropriate repair procedure will be agreed upon between the Owner, Installer, testing agency, and Engineer. The procedures available include:

1. Patching, used to repair large holes, tears, undispersed raw materials, and contamination by foreign matter.

2. Grinding and reseaming, used to repair small sections of extruded seams.

3. Spot seaming, used to repair small tears, pinholes or other minor localized flaws.

4. Capping, used to repair large lengths of failed seams.

5. Topping, used to repair areas of inadequate seams, which have an exposed edge.

D. The following provisions regarding the repairs shall be satisfied:

1. Surfaces of the geomembrane which are to be repaired shall be abraded no more than one hour prior to the repair, if applicable.

2. All surfaces shall be clean and dry at the time of the repair.

3. All seaming material and equipment used in repairing procedures shall be approved.

4. The repair procedures, materials, and techniques shall be approved in advance of the specific repair by the Engineer and Installer.

5. Patches or caps shall extend at least 6 in. beyond the edge of the defect, and all corners of patches shall be rounded with a radius of at least 3 in.

6. The geomembrane below large caps shall be appropriately cut to avoid water or gas collection between the two sheets.

E. Verification of Repairs: Each repair will be numbered and logged by the testing agency. Each repair shall be non-destructively or destructively tested using the methods described in Paragraphs 3.09 and 3.10 as appropriate. Repairs which pass the non destructive test will be taken as an indication of an adequate repair. Large caps may be of sufficient extent to require destructive testing, at the discretion of the Engineer and testing agency. Failed tests will require the repair to be redone and retested until a passing test results. The Engineer and testing agency will observe all non destructive testing of repairs and will record the date of the repair and test outcome.

F. Large Wrinkles: When seaming of the geomembrane is completed (or when seaming of a large area of the geomembrane is completed) and prior to placing overlying materials, the Engineer and testing agency will observe the geomembrane for wrinkles. The Engineer and testing agency will indicate to the Owner which wrinkles should be cut and reseamed by the Installer. The seam thus produced will be tested like any other seam.

3.12 LINER INSTALLATION INSPECTION AND TESTING

A. An independent testing agency retained by the Owner will perform field testing and inspection of the geotextiles and HDPE liner installation under the provisions of Section 01400.

B. The testing agency shall perform the quality assurance functions during the installation of the HDPE liner as described in previous sections of this specification and as follows:

1. Verifying bills of lading and correspondence packing list confirming receipt of all liner installed at the site.

2. Verifying panel layout with liner roll numbers. Locations where damage was encountered and repaired shall be marked.

3. Recording location and roll numbers from which samples were taken for conformance tests, along with the results of those tests.

4. Verifying that the requirements for the subgrade were achieved. Description of deviations, if any, made to the original construction plan (as proposed at the initiation of installation).

5. Full time observation of geogrid, geotextile and geomembrane installation.

6. Performing quality assurance functions described in these specifications.

7. Overseeing all testing procedures.

8. Preparation of daily reports of the activities undertaken at the site during construction. Reports of all testing performed.

C. All field inspection and testing shall be performed under the supervision and review of a Professional Engineer licensed in the State of Pennsylvania employed by the testing agency.

D. At the completion of the project, the testing agency shall submit a written statement verifying that, based on its inspection and testing, the geotextile and liner installation has been performed in accordance with the contract Documents. This statement must be signed by the testing agency's licensed Professional Engineer.

E. The geotextile and geomembrane Quality Control shall be conducted by a Geosynthetics Accreditation Institute Lab Accreditation Program (GAI LAP) accredited test laboratory.

3.13 LEAK LOCATION SURVEY

A. An independent testing agency retained by the Owner shall perform an electrical leak location survey on each lagoon after the liner is installed and 12-inch soil cover material is in place but prior to installation of riprap.

B. The survey shall be conducted on the entire liner surface including the bottom of the lagoon and the side slopes of the lagoon extending to the top of the berm.

C. Electrical isolation will be achieved by leaving a minimum of 6 inches of bare liner protruding from the backside of the backfilled liner anchor trench.

D. The leak location equipment and procedures shall be capable of locating a 0.125-inch diameter (1/8 inch) hole in the geomembrane. The leak survey Contractor shall demonstrate and document this capability using an artificial or actual leak in a manner suitable and acceptable to the Owner's representative. The leak location firm shall demonstrate that the specified leak can be detected when the leak is midway between the four nearest measurement positions.

E. The general results of the survey will be reported to the Owner's representative at the end of each day. A mark or flag shall be placed on the protective soil indicating the location of any leak located. Markings shall be made to withstand rain, accumulating water and high winds.

F. After a leak is found, the Contractor shall be responsible for removing the protective soil and geotextile to expose the leak, repairing the leak in accordance with these specifications and repairing and replacing the geotextile and soil cover. After the leak is repaired, the leak location Contractor will re survey the area within a 25 feet radius. If no additional leaks are found within this area, the leak is considered repaired.

G. A letter report will be prepared and submitted to the Owner's representative no later than 15 calendar days after the completion of the survey. This report shall contain a description of the methodology used, a list of leaks found with their locations and descriptions noted and the results of the retesting all leak repairs.

H. After completion of the leak survey (all leaks have been repaired and the area resurveyed successfully) the 6-inch section of bare liner will be covered as required by the Contract Documents.

I. The Contractor shall fully cooperate with the leak survey, including removal of all standing water from the surface of the soil cover for the duration of the survey and providing electrical isolation of the liner at the liner trench.

3.13 LINER SYSTEM CERTIFICATION/ACCEPTANCE

A. The Contractor and Installer shall retain all ownership and responsibility for the liner system until acceptance by the Owner.

B. The liner system will not be accepted by the Owner until:

1. The installation is finished.

2. Verification of the adequacy of all seams and repairs, including associated testing, and documentation of installation is complete.

3. Installer's representative furnishes the Owner with certification that the geomembrane was installed in accordance with the manufacturer's recommendations as well as the Drawings and Specifications and provides a written, signed and notarized I year warranty.

4. The leak survey report has been received. The report must indicate all leaks have been satisfactorily repaired.

5. The testing agency submits a written statement verifying that, based on its inspection and testing, the liner construction has been performed in accordance with the Contract Documents. This statement must be signed by the testing agency's licensed Professional Engineer.

3.14 QAQC FORMS

A. Attached are QAQC forms to be utilized during installation of work of this section. Forms are to be completed by testing agency with assistance from Installer. Forms included are:

1. QAQC 1 Liner Project QA/QC Log
2. QAQC 2 Subgrade Surface Acceptance
3. QAQC 3 Receiving QA/QC Log
4. QAQC 5 Daily Panel Placement QA/QC Log
5. QAQC 6 Daily Seaming QA/QC Log
6. QAQC 7 Daily QA/QC Report Field Seam Samples
7. QAQC 9 Destructive Testing Log

3.15 PROTECTION OF INSTALLED WORK

A. Protect finished Work in accordance with the manufacturer's recommendations.

B. Prevent any unauthorized entry to lined lagoon.

END OF SECTION

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QAQC 1

LINER PROJECT QA/QC LOG

PROJECT NAME:

PROJECT NUMBER:

PROJECT LOCATION: Buckingham Township

PROJECT OWNER: Buckingham Township

ADDRESS: P.O. Box 413, Buckingham Pa

CONTACT: Operations Director

PHONE: 215-794-8834

PROJECT ENGINEER: Castle Valley Consultants

ADDRESS: 10 Beulah Rd. New Britain PA

CONTACT: Gary Weaver P.E.

PHONE: 215-348-8257

GENERAL CONTRACTOR: _____

ADDRESS: _____

CONTACT: _____

PHONE: _____

SPECIFIED LINER MATERIALS: Geomembrane Liner

THICKNESS & TYPE: 60 mils HDPE (High Density Polyethylene)

SUPPLIER OF LINER MATERIALS: _____

ADDRESS: _____

CONTACT: _____

PHONE: _____

MATERIAL CERTIFICATION RECEIVED: Yes No

DATE: _____

ACCEPTED: Yes No

FABRICATOR OF MATERIAL: _____

INSTALLER OF MATERIAL: _____

QA/QC INSPECTION FIRM: _____

ADDRESS: _____

CONTACT: _____

PHONE: _____

LINER TESTING LABORATORY: _____

ADDRESS: _____

CONTACT: _____

PHONE: _____

QAQC 2

SUBGRADE SURFACE ACCEPTANCE (One per area)

PROJECT NAME:

PROJECT NUMBER:

DATE: _____

GENERAL CONTRACTOR: _____

ADDRESS: _____

_____

SUPERINTENDENT OF PROJECT: _____

PHONE: _____

GEOMEMBRANE INSTALLER: _____

ADDRESS: _____

_____

SUPERINTENDENT OF PROJECT: _____

PHONE: _____

CERTIFICATE OF ACCEPTANCE OF SUBBASE SOIL BY INSTALLER

I, the Undersigned, duly authorized representative of _____do hereby accept the soil surface as being acceptable for the placement of a Geomembrane liner.

Name _____

Signature _____

Title _____

Date _____

CERTIFICATE ACCEPTED BY INSPECTOR

Company: _____

Name _____

Signature _____

Title _____

Date _____

CERTIFICATE ACCEPTED BY CONTRACTOR

Company: _____

Name _____

Signature _____

Title _____

Date _____

QAQC 3

RECEIVING QA/QC LOG (One per truck)

PROJECT NAME:

PROJECT NUMBER:

DATE: _____

TIME: _____

TRUCKER'S ID: _____

NUMBER OF PIECES ON BOARD: _____

AGREE WITH PACKING LIST? Yes No

CONDITION OF PACKAGING: _____

_____

VERIFY PROPER MATERIALS: Yes No

VERIFY PROPER THICKNESS: Yes No

IDENTIFY PANEL NUMBERS: Yes No

IDENTIFY ACCESSORIES: _____

_____

IDENTIFY DAMAGED ITEMS: Yes No (attach list of damages)

TYPE OF UNLOADING EQUIPMENT USED: _____

OPERATOR: _____

COMMENTS: _____

_____

STORAGE AREA _____

CONDITION (SURFACE): _____

MATERIAL PROPERLY COVERED: Yes No

WEATHER CONDITIONS: _____

TEMPERATURE: _____

QA/QC INSPECTOR: _____

SITE SUPERVISOR: _____

QAQC 5

DAILY PANEL PLACEMENT QA/QC LOG

(Placement of panels for seaming)

(One sheet per day of placement)

PROJECT NAME:

PROJECT NUMBER:

DATE: _____

TEMPERATURE BEGINNING: _____

MID DAY: _____

ENDING: _____

CONDITION: Rain Snow Cloudy Sunny

ACTUAL HOURS WORKED: _____

NUMBER OF CREW: _____

CREW LEADER: _____

OTHER ACTIVITIES: (Placement of sand bags, etc.)

_____

_____

_____

TYPE OF PLACEMENT EQUIPMENT: _____

OPERATOR: _____

LINER INFORMATION

NUMBER OF PANELS PLACED: _____

TOTAL S.F. PLACED: _____

PANEL I.D. NUMBERS: _____

COMMENT ON SITE CONDITION:

_____

_____

_____

LINEAL FEET OF ANCHOR TRENCH DUG: _____

QA/QC INSPECTOR: _____

SITE SUPERVISOR: _____

QAQC 6

DAILY SEAMING QA/QC LOG

(Field seaming of panels, One sheet per seaming crew per day)

PROJECT NAME:

PROJECT NUMBER:

DATE: _____

TEMPERATURE BEGINNING: _____

MID DAY: _____

ENDING: _____

CONDITION: Rain Snow Cloudy Sunny

ACTUAL HOURS WORKED: _____

NUMBER OF CREW: _____

CREW LEADER: _____

SEAMING INFORMATION

TOTAL LINEAL FEET OF FIELD SEAM SEALED: _____

SEAMS WIDTH

MINIMUM: _____

ACTUAL: _____

BOND AREA: _____

TESTING

TOTAL LINEAL FEET OF FIELD SEAM TESTED: _____

TEST METHOD: _____

NUMBER OF SEAM REPAIRS REQUIRED _____

(list location here and on as built):

_____

_____

NUMBER OF SEAM SAMPLES MADE OR

CUT FOR DESTRUCTIVE TESTING: _____

(list location here and on as built):

_____

_____

DESCRIPTION OF OTHER WORK PERFORMED TODAY:

_____

_____

QA/QC INSPECTOR: _____

SITE SUPERVISOR: _____

QA/QC 7

DAILY QA/QC REPORT

FIELD SEAM SAMPLES

(Field seam test samples, One sheet per sample)

PROJECT NAME:

PROJECT NUMBER:

DATE: _____

TIME SAMPLE MADE AND/OR CUT: _____

CREW IDENTIFICATION (CREW LEADER): _____

SAMPLE IDENTIFICATION: _____

LOCATION OF SEAM: _____

WELD TYPE Fusion Extrusion Chemical Adhesive

MACHINE TEMPERATURE: _____

WEATHER AT TIME SEAM SAMPLE WAS MADE:

TEMPERATURE BEGINNING: _____

MID DAY: _____

ENDING: _____

CONDITION: Rain Snow Cloudy Sunny

HAS A TEST SAMPLE BEEN RETAINED FOR RETESTING? Yes No

TEST REQUIRED OF THIS SAMPLE (SHEAR & PEEL):

SHEAR RESULTS:		PEEL RESULTS:	
#1	_____	#1	_____
#2	_____	#2	_____
#3	_____	#3	_____
#4	_____	#4	_____
#5	_____	#5	_____

CONSTRUCTION QA MONITOR ID: _____

RETURN RESULTS TO: _____

QA/QC INSPECTOR: _____

SITE SUPERVISOR: _____

QAQC 9

DAILY QA/QC REPORT

DESTRUCTIVE TESTING LOG

(Destructive test samples)

(One sheet per sample)

PROJECT NAME: Sheeder Tract Wastewater Treatment Plant

PROJECT NUMBER: 59-2.2

DATE: _____

TIME SAMPLE MADE AND/OR CUT: _____

CREW IDENTIFICATION (CREW LEADER): _____

SAMPLE IDENTIFICATION: _____

LOCATION OF SAMPLE: _____

SAMPLE SIZE: _____

REASON FOR SAMPLE: _____

WELD TYPE Fusion Extrusion Chemical Adhesive

TYPE OF TESTING Field Laboratory

LABORATORY USED: _____

HAS A TEST SAMPLE BEEN RETAINED FOR RETESTING? Yes No

TEST REQUIRED OF THIS SAMPLE Seam Strength Peel

SEAM STRENGTH RESULTS:		PEEL RESULTS:	
#1	_____	#1	_____
#2	_____	#2	_____
#3	_____	#3	_____
#4	_____	#4	_____
#5	_____	#5	_____

CONSTRUCTION QA MONITOR ID: _____

RETURN RESULTS TO: _____

QA/QC INSPECTOR: _____

SITE SUPERVISOR: _____

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SECTION 02229

BLASTING

PART 1 GENERAL

1.01 SUMMARY

A. Work Included

1. Removal of rock during excavation for structures and roads

2. Removal of rock during excavation for utility trenches

1.02 REFERENCES

A. NFPA 495 - Code for the Manufacture, Transportation, Storage, and Use of Explosive Materials.

B. Buckingham Township Blasting Permit

1.03 QUALITY ASSURANCE

A. CONTRACTOR shall employ a seismic survey firm if explosives are to be used Seismic survey firm shall be a company specializing in seismic surveys with five years documented experience

B. If explosives are to be used, CONTRACTOR shall have five years experience or shall employ a firm with five years experience with use of explosives

C. Blaster shall hold necessary licenses for the type of work performed and comply with all provisions contained in Township Permit

1.04 REGULATORY REQUIREMENTS

A. CONTRACTOR shall conform to applicable federal, state, and local codes for explosive disintegration of rock.

B. CONTRACTOR shall obtain permits from authorities having jurisdiction before explosives are brought to site or drilling is started.

C. No explosives shall be used without written permission from OWNER.

1.05 PROJECT CONDITIONS

A. CONTRACTOR shall conduct survey and document conditions of buildings near locations of rock removal, both prior to and after blasting, in the presence of adjacent property owners and shall advise owners of adjacent buildings or structures in writing, prior to executing seismographic survey.

B. CONTRACTOR shall obtain a seismic survey prior to rock excavation to determine maximum charges that can be used at different locations in area of excavation without damaging adjacent properties or other work.

1.06 SUBMITTALS:

A. Submit a copy of the Blasting Activity Permit issued by the Commonwealth Of Pennsylvania in accordance with the provisions of the Administrative Code of 1929 (Section 1917-A) and 25 PA Code Chapter 211.

B. Submit two (2) copies of blaster's license to the engineer.

C. Submit a copy of the blasting plan submitted to the Department of Environmental Protection. Indicate all safety measures to be in effect during blasting operations.

D. Provide daily blasting reports to the Engineer.

PART 2 PRODUCTS

2.01 MATERIALS

A. Explosives: Type recommended by explosives firm following seismic survey and required by authorities having jurisdiction.

B. Delay Devices: Type recommended by explosives firm.

C. Blasting Mat Materials: Type recommended by explosives firm.

2.02 BLAST DESIGN

A. Blasts shall be designed and conducted in a manner to achieve either a minimum scaled distance of 90 or meet the maximum allowable peak particle velocity indicated by Figure 1 of PA Code Chapter 211.151 (c) at the closest building not owned or leased by the Owner. Blasts shall be designed and conducted to control air blast so that it does not exceed the noise levels specified in Table 1 of PA Code Chapter 211.151 (d) at the closest building not owned or leased by the Owner or any other structure designated by the Department of Environmental Protection.

PART 3 EXECUTION

3.01 BEFORE BLASTING

A. Pre-Blast Survey

1. A pre-blast survey shall be done prior to blasting. They survey is conducted by a company or individual independent of the blasting company. The surveyor shall documents both exterior and interior conditions. The surveyor shall record the condition of the structure before blasting and any other physical factors that blasting could affect.

The surveyor shall also record the quality of private water supplies. Copies of the survey are sent to the homeowner, the Owner, and any other Authority having before approval of a blasting plan for that operation.

B. Public Notice

1. The public must be informed before blasting can take place at the site. The Owner will require the Contractor to publish a blasting schedule in a newspaper of general circulation. A blasting schedule contains the following information:

   a. Days and times when blasting will occur.

   b. Areas where blasting will take place.

   c. Descriptions of audible warning and "all clear" signals which will be sounded before and after blasting.

2. Advise owners of adjacent buildings or structures in writing prior to setting up seismographs. Describe blasting and seismic operations.

3.02 DURING BLASTING

A. Seismographs

1. The Owner will require seismic data collection. An independent company conducts the analysis of seismic data. This company must be unrelated to both the blaster and the Contractor.

B. Blasting Safety Measures

1. Blasters must meet all state requirements during blasting. They include, but are not limited to the following:

   a. While using explosives, the blaster must secure the blast area and put up signs indicating that explosives are being used.

   b. Roads adjacent to a blast site are blocked before firing a blast.

   c. Blasters must inspect the blasting area before and after a blast.

   d. Blasting may occur only between sunrise and sunset.

3.03 AFTER BLASTING

A. Blast Report

1. Blasters shall file a detailed blast report every time they blast. The blast report includes the name of the operator, blaster, and seismograph operator if one was needed. The report also states the type of material blasted, types of explosives used, and the total amount of explosives

used. The report includes the distances and direction to the nearest building neither owned nor leased by the person conducting the blasting.

B. Damages Claimed

1. Any damages claimed shall be investigated by the Owner and the Department of Environmental Protection. Blast reports and seismic data are reviewed for completeness, accuracy, and regulatory compliance. The Department and the Owner has no authority to require compensation if damage occurs. Compensation for damage is strictly a civil matter between the Contractor and the landowner. Where a potential for damage may exist the Department may require modification of the blast plan to reduce vibration levels. If the blast plan has been violated, enforcement action will be taken.

END OF SECTION

SECTION 02275

RIPRAP

PART 1 GENERAL

1.01 SUMMARY

A. Work Included furnishing and placing riprap

1.02 QUALITY ASSURANCE

A. REFERENCES:

This section contains references to the following document. It is a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed document, the requirements of this section shall prevail.

PADOT Publication Form 408, Latest edition

1.03 SUBMITTALS

A. Submit under provisions of Section 01300.

1.04 QUALITY ASSURANCE

A. Perform Work in accordance with Section 01400.

PART 2 PRODUCTS

2.01 MATERIALS

A. Stone for riprap shall be durable quarry stone of approved quality. It shall be sound, hard, dense, resistant to the action of air and water, and free from seams, cracks, or other structural defects.

B. Stone for riprap shall be m accordance with Form 408, Gradation R-3.

PART 3 EXECUTION

3.01 PREPARATION

A. The bed for the riprap shall be properly trimmed and shaped before geotextile and stone is placed. Bed shall be minimum 6 inches thick

B. Geotextile shall be placed below riprap.

3.02 INSTALLATION

A. Riprap shall be provided in areas as designated on the drawings.

B. Stone placed above the water line shall be placed by hand. It shall be laid with close, broken joints and shall be firmly bedded into the slope and against the adjoining stones. The stones shall be laid perpendicular to the slope with ends in contact

C. The riprap shall be thoroughly compacted as construction progresses and the finished surface shall present an even, tight surface

D. The large stone shall be placed in the lower courses Interstices between stones shall be chinked with spalls firmly rammed into place

E. Unless otherwise shown or specified, riprap shall be at least 18 inches in thickness, measured perpendicular to the slope

END OF SECTION

SECTION 02310

HORIZONTAL DIRECTIONAL DRILLING

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

The Developer/Contractor shall provide all investigation, planning, geotechnical work, equipment, labor, etc. necessary to properly install the proposed directional bores as indicated on the construction using horizontal directional drilling (directional boring) technology. Pipe materials shall match those indicated on the plans.

1.02 SUBMITTALS

A. Submit under provisions of Section 01300, for the following materials, and include the following information:

1. High density polyethylene pipe: product descriptions, cell certifications and other information demonstrating conformance with this specification.

B. Shop Drawings: Indicate detailed dimensions, post with concrete foundation details, brace and anchor requirements.

C. Product Data: Provide product data on rails, posts and accessories.

D. Manufacturer's Installation Instructions: Indicate installation requirements and special procedures.

1.03. Quality Assurance

A. Where reference is made to an ASTM, ANSI, AASHTO, and AWWA designation, it shall be the latest revision.

B. All pipes shall have a homing mark on the spigot end provided by the manufacturer. On field cut pipe, Contractor shall provide homing mark on the spigot end in accordance with manufacturer’s recommendations.

C. Each length of pipe shall bear the name or trademark of the manufacturer, the location of the manufacturing plant, and the class or strength classification of the pipe. The markings shall be plainly visible on the pipe barrel. Pipe which is not marked clearly is subject to rejection. All rejected pipe shall be promptly removed from the project site by the Contractor.

D. All pipe and accessories to be installed under this Contract shall be inspected and tested at the place of manufacture by the manufacturer as required by the Standard Specifications to which the material is manufactured.

E. Materials

The Engineer will inspect all materials before and after installation to ensure compliance with the Specifications.

F. Field Tests

1. General

a. After installation, mains will be initially inspected by the Engineer and shall be Contractor tested for compliance with these Specifications. Initial inspections and tests will not be conducted until at least 48 hours after all concrete thrust blocks and anchors have been constructed and backfilling completed on the section of main being tested. The Contractor shall furnish all labor, tools, materials, and equipment necessary to perform the specified tests. The contractor/his supplier shall demonstrate that all valves and miscellaneous components of the piping system fully functional and in proper working order prior to acceptance.

b. The mains and appurtenances shall be tested in accordance with its applicable water or sewage pressure testing defined in their particular specification.

c. The Contractor shall schedule all tests with the Engineer at least 48 hours in advance of the test, and shall conduct all acceptance testing in the presence of the Engineer

d. Generally, mains will be tested from end to end. Pressure and leakage tests shall be performed.

2. Testing of Polyethylene Pipe

a. Butt Fusion Testing: On every day butt fusions are to be made; the first fusion of the day shall be a trial fusion. The trial fusion shall be allowed to cool completely, and then fusion test straps shall be cut out. The test strap shall be 12" (min) or 30 times the wall thickness in length with the fusion in the center, and 1" (min) or 1.5 times the wall thickness in width. Bend the test straps until the ends of the strap touch. If the fusion fails at the joint, a new trial fusion shall be made, cooled completely and tested. Butt fusion of pipe to be installed shall not commence until a trial fusion has passed the bent strap test.

b. Pressure Testing: Hydrostatic Pressure testing shall be conducted in accordance with ASME B31.1, ASME B31.8 Appendix N, PPI Handbook of Polyethylene Pipe, Inspections, Tests, and Safety Standards, (formerly PPI TR-31 Underground testing of Polyolefin Piping), and Manufacturer's recommendations. Pneumatic pressure testing shall not be used.

1.04 PIPE HANDLING

A. All types of pipes shall be handled in such manner as will prevent damage to the pipe or coating. Accidental damage to pipe shall be repaired to the satisfaction of the Owner or be removed from the job. When not being handled, the pipe shall be supported on timber cradles or on properly prepared ground, graded to eliminate all rock points and to provide uniform support along the full length. When being transported, the pipe shall be supported at all times in a manner which will not permit distortion or damage to the lining or coating. Any unit of pipe that, in opinion of the Owner, is damaged beyond repair by the Contractor, it shall be removed from the site of the work and replaced with another unit.

B. Dirt or other foreign material shall be prevented from entering the pipe or pipe joint during handling or laying operations and any pipe or fitting that has been installed with dirt or foreign material in it shall be removed, cleaned and reinstalled. At times when pipe installation is not in progress, the open ends of the pipe shall be closed by a watertight plug or by other means approved by the Owner to ensure absolute cleanliness inside the pipe.

PART 2 PRODUCTS

2.01 PRESSURE PIPE AND FITTINGS FOR HORIZONTAL DIRECTIONAL DRILLING

A. Ductile iron pipe for horizontal directional drilling

1. Ductile Iron Pipe for horizontal directional drilling shall be restrained and boltless flexible joint pipe as approved by the Engineer.

2. The Ductile Iron Pipe material shall meet the minimum requirements of Technical Specification Section 02550. Additionally, the joints shall meet the requirements of ANSI/AWWA C111/A21.11.

B. Polyvinyl chloride pipe (PVC) for horizontal directional drilling

1. Products delivered under this specification shall be manufactured only from water distribution pipe and couplings conforming to AWWA C900 or AWWA C905, as appropriate for the size of the watermain indicated on the plans. Pipe materials and joints shall be rated for 200 psi or greater.

2. Pipe and couplings shall be made from unplasticized PVC compounds having a minimum cell classification of 12454-B, as defined in ASTM D1784. Pipe, couplings, and locking splines shall be completely non-metallic. The compound shall qualify for a Hydrostatic Design Basis (HDB) of 4000 psi for water at 73.4ºF, in accordance with the requirements of ASTM D2837.

3. Pipe shall be joined using non-metallic couplings to form an integral system for maximum reliability and interchangeability. High-strength, flexible thermoplastic

splines shall be inserted into mating, precision-machined grooves in the pipe and coupling to provide full 360º restraint with evenly distributed loading.

4. Couplings shall be designed for use at or above the rated pressures of the pipe with which they are utilized, and shall incorporate twin elastomeric sealing gaskets meeting the requirements of ASTM F477. Joints shall be designed to meet the leakage test requirements of ASTM D3139.

5. Approved manufacturer includes C900/RJ™ PVC restrained-joint pipe or C905/RJ™ PVC restrained-joint pipe from CertainTeed Corporation and any other manufacturer approved by Engineer.

C. High-density polyethylene (HDPE) for horizontal directional drilling

1. Pipes: HDPE force main pipe shall meet the requirements for Type III, Grade P345 Polyethylene Material as defined in ASTM Specification D-1248 (PE 3408). The minimum pressure class/SDR rating acceptable shall be Class 200/SDR 11. The pipe shall be DIPS and shall have an interior diameter no less than the piping that it is connected to.

2. Joints: Joints shall be of a heat fusion joining system. Pipe and fittings shall be thermal butt fusion, saddle fusion, or socket fusion in accordance with manufacturer recommended procedures and ASTM D-2161. At the point of fusion, the outside diameter and minimum wall thickness of the fitting shall match the outside diameter and minimum wall thickness specifications of ASTM D-1248 for the same size pipe.

   Joining of the pipes and fittings shall be performed in accordance with ASTM D-2774. Depending upon the installation requirements and site location, joining shall be performed within or outside the excavation. Joints of the pipe sections shall be smooth on the inside and internal projection beads shall not be greater than 3/16 inch.

   The tensile strength at yield of the butt-fusion joints shall not be less than the pipe. A specimen of the pipe cut across the butt-fusion joints shall be tested in accordance with ASTM D-638

   The manufacturer shall provide fusion training. The contractor and the onsite joint inspector shall be trained by the manufacturer or manufacturer's authorized representative.

   The fusion equipment and operator shall be required to demonstrate successful field experience. Regarding fusion over 36" capability, the fusion unit shall be field tested for a period of five years and the fusion operator shall have pipe size experience of the same size pipe on this project for five years or longer.

3. Fittings: All fitting shall be provided as indicated on the plans. HDPE Fittings shall be of the same material and class as the pipe and shall be manufactured by the manufacturer of the pipe. HDPE Elbows, tees, and wyes shall be manufactured by

mitered fabrication. The manufacturer shall have a written specification for all standard mitered fittings, which establishes Quality Control criteria and tolerances. The manufacturer may be required to demonstrate its ability to produce product required by this specification.

Mechanical joint anchor fittings (MJ Adapter) shall be used to transition from ductile iron to HDPE and from HDPE to PVC. The fitting shall be stronger than the pipe in that when it is subjected to tensile stress the pipe will pull apart before the fitting will pull out and the pipe will blow before the fitting will rupture under pressure.

The MJ Adapter shall have a pre-installed stainless-steel stiffener, in accordance with Plastic Pipe Institute (PPI) recommendations, to neutralize point-loading, ACQ, creep and loss of gasket seal due to diameter contraction. The stiffener shall be engineered sufficiently thick to avoid redial buckling due to gasket pressure.

The MJ Adapter requires longer bolts and shall be sold with the modified longer bolt kit to avoid construction crew delays or improper installation with too short bolts.

All fittings for force mains or pressure rated fittings shall be rated according to the manufacturer's written specifications, and clearly labeled on the fittings as such.

4. Installation: The installation shall conform to the requirements of the manufacturer, the AWWA Standard, and as indicated on the plans and specified herein.

5. Marking and Certification: Each length of HDPE sanitary sewer shall be clearly marked with the Manufacturer's Name, Tradename or Trademark, Nominal pipe size, Pipe Stiffness, Production Code/Extrusion Code, Material Cell Class Designation and ASTM number.

   The pipe manufacturer shall provide certification that the stress regression testing has been performed on the specific product. The said certification shall include a stress live curve per ASTM D-2837. The stress regression testing shall have been performed in accordance with ASTM D-2837, and the manufacturer shall provide a product supplying a minimum Hydrostatic Design Basis of 1,600 psi as determined by ASTM D-2837. This certification shall also state that the pipe was manufactured from one specific resin in compliance with these specifications. The certificate shall state the specific resin used and its source.

PART 3 EXECUTION

3.01 MATERIALS

A. Piping and conduits installed by horizontal directional drilling (directionally bore) shall be HDPE, PVC, DI or Steel as indicated in the plans and other sections of these specifications.

3.02 INSTALLATION

A. Depths of all existing utilities must be confirmed by the CONTRACTOR prior to the crossing to avoid conflicts. Equipment shall be utilized that does not require the conventional bore and receiving pits due to space constraints. Proper connection to the piping at each end shall be done by standard excavation. The CONTRACTOR shall be responsible to provide a slurry containment pit and shall remove all excess material and dispose of appropriately off-site upon completion. All erosion control facilities shall be provided to contain any solids from migrating beyond the project site. If the CONTRACTOR utilizes a subcontractor for this work, they shall provide proof of adequate comprehensive general liability insurance covering underground collapse and explosion and experience to the ENGINEER and OWNER for prior approval. The CONTRACTOR shall be required to provide all necessary water in accordance with other applicable sections of these specifications.

B. In all cases the manufacturer's recommendations and procedures shall be followed regarding the installation of their pipe material by horizontal directional drilling.

C. Subsurface investigation, if deemed necessary, shall be provided prior to bids by the CONTRACTOR. No additional payments will be made if rock is encountered or if soil conditions require additional construction time and equipment. Proper equipment and methods shall be used in rock and soil bores to insure proper grades, elevations and separations.

D. All directional drilling operations shall be performed by a qualified directional drilling CONTRACTOR with at least (3) years' experience involving work of a similar nature to the work required of this project. The CONTRACTOR must have installed a minimum of 10,000 linear feet of pipe (4-inch diameter or greater) using directional drilling operations. A list of project references and proof of contractor experience shall be presented to the ENGINEER, upon request by the ENGINEER.

E. The requirements of all applicable local and state authorities shall be followed by the CONTRACTOR.

F. The piping shall be installed at the minimum depths indicated in the plans and shall deviate no more than six inches along the vertical axis and 2' along the horizontal alignment.

G. The CONTRACTOR shall provide accurate As-Built data based on downhole survey data or a walkover location system that indicates x, y and z coordinates of the pipe at least every thirty (30) feet along the alignment or at a midpoint if the bore length is less than thirty (30) feet.

END OF SECTION 02310

SECTION 02401

DEWATERING

PART 1 GENERAL

1.01 SUMMARY

A. Work Included

1. Removal of groundwater to allow below grade construction

2. Site grading to prevent surface water from entering the excavation

1.02 SYSTEM REQUIREMENTS

A CONTRACTOR shall at its own expense, keep the excavation clear of water while structures, mains, and appurtenances are being built, utilities are being installed, and fill and backfill are being compacted. Under no conditions shall the work be laid in or underwater. No water shall flow over the work until the joints are complete or the concrete has set.

B. Dewatering shall be sufficient to lower the piezometric level to at least two feet below the bottom of the excavation. Additional lowering shall be provided as necessary to create a stable subgrade.

C. In areas where rock is encountered, the water level shall be kept at or below top of rock, but at least 6 inches below bottom of concrete. Additional rock shall be removed as needed to provide clearances.

D. The control of groundwater shall be such that softening or heaving of the bottom of excavations or formation of "quick" conditions or "boils" shall be prevented.

E. Dewatering systems shall be designed and operated so as to prevent the migration or removal of soils.

F. The Contractor shall select, employ and pay for the services of a Licensed Pennsylvania well driller to keep all excavations and structures free from water while the construction work is in progress and to such an extent as may be necessary while excavation work is being carried on. He shall provide for the proper disposal of the water in such a manner as to not disturb or impede other construction activities. Discharge of water is to be according to the E & S plan for the activity. A licensed well driller is required only where wells are used for dewatering.

1.03 QUALITY ASSURANCE

A. All dewatering shall be done in accordance with applicable federal, state, and local code requirements.

PART 2 PRODUCTS

(Not used)

PART 3 EXECUTION

3.01 GENERAL

A. Dewatering shall be accomplished by use of well points or pumping directly from excavation or trenches as approved by the Engineer. In order to assure continuous dewatering, duplicate pumping units of the selected system incorporated with emergency power should be employed so that a reliable operation may be obtained. It is absolutely essential that all excavations be kept dry during the construction.

3.02 PROTECTION

A. CONTRACTOR shall take all necessary precautions during the dewatering operation to protect adjacent structures against subsidence, flooding or other damage. The dewatering system shall be installed and operated so that the groundwater level outside the excavation is not reduced to the extent that would damage or endanger structures or property on-site or off-site within the area of influence of the dewatering operation. Any such facilities and structures damaged shall be repaired or replaced to the satisfaction of their owner at CONTRACTOR's expense.

B. Prior to dewatering, CONTRACTOR shall take into account the effect of its proposed dewatering operation on existing public and private water supply systems and their potability and shall make arrangements with property owners for protecting their supplies or providing alternative means of temporary or permanent supply at CONTRACTOR's expense. Alternative means of supply shall be in accordance with all applicable regulations, codes, and ordinances.

3.03 DEWATERING

A. All permanent improvements shall be constructed in areas free from water. The Contractor shall construct and maintain all permanent or temporary slopes, dikes, levees, drainage ditches, sumps, and observation wells necessary for the removal of water work areas. The Contractor shall design, furnish, install, maintain, and operate all necessary pumping and other dewatering equipment required for dewatering and various work areas and for keeping the foundation and other work areas free from water from any and all sources.

B. All dewatering shall be performed in advance of excavation. The dewatering shall be accomplished in a manner that will prevent loss of fines from the foundation, will maintain stability of all excavated slopes and bottoms of excavations, and will permit all construction operations to be performed in a dry environment. Dewatering of excavation shall be performed to the extent required to permit placement of compacted fill materials in a dry environment and to prevent sloughing of the excavation side slopes.

3.04 DISPOSAL OF DRAINAGE WATER

A. The disposal of all water from the dewatering and control of water operation and surface drainage shall be accomplished in a manner to have no detrimental effect on any of the new or existing facilities. The method and location of disposal of all water shall be subject to the approval of the Engineer and Bucks County Conservation District. In addition, no water shall be drained into work built or under construction without prior consent of the Engineer.

END OF SECTION

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SECTION 02510

ASPHALTIC CONCRETE PAVING

PART 1 GENERAL

1.01 SUMMARY

A. Work includes asphaltic concrete paving, and tack coat.

B. CONTRACTOR is cautioned that existing pavement may not hold up to typical construction traffic or activities CONTRACTOR shall repair all roads, shoulders, and paved areas damaged during the project in accordance with this section Gravel shoulders, gravel roads, and parking areas shall be repaired to accordance with Section 02231- Aggregate Base Course.

1.02 QUALITY ASSURANCE

A. REFERENCES:

This section contains references to the following document. It is a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed document, the requirements of this section shall prevail.

PADOT Publication Form 408, Latest edition

1.03 DEFINITIONS

A Street or road shall include streets, roads, driveways, and parking lots.

1.04 SUBMITTALS

A. Submit sieve analysis for proposed materials in accordance with Section 01300 Submittals

PART 2 PRODUCTS

2.01 ASPHALTIC CONCRETE PAVEMENT

A. Materials for bituminous wearing course ID-2 (standard) pavement shall be as specified in Section 420 of PADOT specifications.

B. Materials for bituminous binder course ID-2 (standard) pavement shall be as specified in Section 421 of PADOT specifications.

C. Materials for tack coat shall conform to the requirements of Section 460

PART 3 EXECUTION

3.01 ALLOWABLE REMOVAL OF PAVEMENT

A. CONTRACTOR may be required to remove bituminous pavement and road surface as a part of the general excavation. The width of pavement removed shall be the minimum possible, and acceptable, for convenient and safe installation of structures, utilities, and appurtenances

B. All bituminous pavements shall be cut on neat, straight lines and shall not be damaged beyond the limits of the excavation as shown on the drawings. Should the cut edge be damaged, a new cut shall be made in neat; straight lines parallel to the original cut encompassing all damaged areas. Pavement removal shall be extended to a seam or joint if seam or joint is within 3 feet of damaged pavement

3.02 TACK COAT

A. All work shall be in accordance with Form 408

B. If asphaltic surface course is applied to an existing street, or is not applied the same day as binder course, the existing street or binder surface shall be tack coated prior to surface paving. Prior to placement of tack coat the streets shall be thoroughly cleaned and broomed. Tack coat shall be applied at a rate of 0.05 gallons per square yard immediately prior to placement of asphaltic surface course

C. In situations where traffic must be maintained, tack coat shall not be placed on the traveled half of the street until traffic can be switched to the new pavement

3.03 JOINTS

A. Joints between old and new pavements or between successive day's works shall be constructed and treated as to insure thorough and continuous bond between the old and new mixtures. Transverse construction joints shall be constructed by cutting the material back for its full depth so as to expose the full depth of the course. Where a header is used, the cutting may be omitted provided the joint conforms to the specified thickness. These joints shall be treated with tack coat material applied with a hose and spray nozzle attachment to fully coat the joint surface.

B. The longitudinal joint shall be made by overlapping the screed on the previously laid material for a width of not more than 2 inches, and depositing a sufficient amount of asphaltic mixture so that the finished joint will be smooth and tight. Longitudinal joints in the Surface course shall at no time be placed immediately over similar joints in the Binder course beneath. A minimum distance of 12 inches shall be permitted between the location of the joints in the Binder course and the location of similar joints in the Surface course above.

3.05 FINISHING ROADWAY

A. The finished base course shall be fine graded in preparation for asphaltic concrete paving. Base course ramps at all existing pavement shall be removed to provide a full depth butt joint. Base course around manhole castings and valve boxes shall be hand trimmed and compacted with a vibratory plate compactor.

3.06 TESTING ASPHALTIC CONCRETE

A. ENGINEER may require samples of asphaltic concrete for testing CONTRACTOR shall cut samples from the finished pavement where marked by ENGINEER and patch the sample area.

3.07 ASPHALTIC PAVING

A. Asphaltic paving work shall include the construction of plant mixed asphaltic concrete pavement in the areas shown on the drawings. All work shall be performed in accordance with Article 406 of the Standard Specifications

B Prior to commencement of paving operations, CONTRACTOR shall examine the finished roadbed CONTRACTOR shall notify ENGINEER of any areas of suspected instability.

C The pavement structure for new roads shall be determined from the standard cross-sections provided on the drawings.

END OF SECTION

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SECTION 02521

CONCRETE STAIRS, SIDEWALKS, AND DRIVEWAY APRONS

PART 1 GENERAL

1.01 SUMMARY

A Work includes concrete stairs, sidewalks, and driveway aprons as shown on the drawings or damaged during construction.

1.02 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Provide product data on curing compound and nosing.

C. Manufacturer's Installation Instructions: Indicate installation requirements and special procedures.

1.03 QUALITY ASSURANCE

A. Perform Work in accordance with Section 01400.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle equipment according to manufacturer's instructions and the provisions of Section 01600.

B. AASHTO M148 Standard Specifications for Liquid Membrane - Forming Compounds for Curing Concrete

A. Unless otherwise specified, all concrete stairs, sidewalks, and driveway apron construction shall meet the requirements of the Section 03300 “Cast-in-place Concrete”

1.05 SCHEDULING AND COORDINATION

A. Schedule work under the provisions of Section 01300.

B. Coordinate the delivery and installation of the work of this Section with the work of other Sections.

1.06 WEATHER LIMITATIONS

A. Placing During Cold Weather

1. Concrete placement shall not take place when the air temperature reaches 40 degrees F and is falling, or is already below that point. Placement may begin when the air temperature reaches 35 degrees F and is rising, or is already above 40 degrees F. Provisions shall be made

to protect the concrete from freezing during the specified curing period. If necessary to place concrete when the temperature of the air, aggregates, or water is below 35 degrees F, placement and protection shall be approved in writing. Approval will be contingent upon full conformance with the following provisions. The underlying material shall be prepared and protected so that it is entirely free of frost when the concrete is deposited. Covering and other means shall be provided for maintaining the concrete at a temperature of at least 50 degrees F for not less than 72 hours after placing, and at a temperature above freezing for the remainder of the curing period.

B. Placing During Warm Weather

1. The temperature of the concrete as placed shall not exceed 85 degrees F except where an approved retarder is used. The mixing water and/or aggregates shall be cooled, if necessary, to maintain a satisfactory placing temperature. The placing temperature shall not exceed 95 degrees F at any time.

PART 2 PRODUCTS

2.01 CONCRETE

A Concrete for sidewalks and driveways shall have a 28-day strength of 3500 psi as specified in Section 03300 “Cast-in-Place Concrete”

2.02 CURING COMPOUND

A. Liquid curing compounds shall conform to the requirements of the Standard Specifications for Liquid Membrane-Forming Compounds for Curing Concrete, AASHTO Designation M148, Type 2, “White Pigmented”.

2.03 NOSING

A. Stair nosing shall be style No.801 as manufactured by American Safety Tread Company, Helena, Alabama 35080 (1-800-245-4881) or equal. Nosings shall be cast in Feracast. Nosings shall terminate not more than 3" from ends of steps for poured concrete stairs; for concrete filled steel pan stairs, nosings shall be full length of steps less 1/8" clearance. Nosings shall be furnished with wing anchors, bolts and nuts or concealed cast anchors. All metals shall be furnished in natural metal finish. Feracast shall have one coat of shop applied black paint.

PART 3 EXECUTION

3.01 BASE PREPARATION

A. The subgrade shall be thoroughly compacted and finished to a trim, firm surface. All soft or unsuitable material shall be removed and replaced with suitable material.

B. A minimum 2-inch thick layer of sand, sand and gravel, or base course shall be placed under all sidewalks. This material shall be thoroughly moistened and compacted before the concrete is placed

3.02 FORMS

A. Forms shall be sufficient strength to resist distortion or displacement. Forms shall be full depth of the required work. Facing boards, if used, shall be built so as to obtain the cross section called for on the drawings. Forms shall be securely staked and held firmly to line and grade Forms shall be cleaned thoroughly and oiled before reuse

B. Forms for sidewalks shall be set with the upper edge true to line and grade with an allowable tolerance of 1/8 inch in any 10-foot long section. After forms are set, grade and alignment shall be checked with a 10-foot straightedge. Forms shall have a transverse slope 1/4 inch per foot with the low side adjacent to the roadway. Side forms shall not be removed for 12 hours after finishing has been completed.

3.04 PLACING AND FINISHING CONCRETE

A. Unless otherwise specified, concrete shall be placed in accordance with Section 03300 “Cast-in-Place Concrete”.

B. Concrete for sidewalk and stairs shall be placed to a minimum thickness of 5 inches, except at driveways, which shall have a minimum thickness equal to the driveway. Driveways shall have a minimum thickness of 6 inches.

C. Concrete shall be placed in the forms in one layer. When consolidated and finished, the sidewalks shall be of the thickness indicated. After concrete has been placed in the forms, a strike-off guided by side forms shall be used to bring the surface to proper section to be compacted. The concrete shall be consolidated with an approved vibrator, and the surface shall be finished to grade with a strike off.

D. Concrete Finishing

1. After straight edging, when most of the water sheen has disappeared, and just before the concrete hardens, the surface shall be finished with a wood float or darby to a smooth and uniformly fine granular or sandy texture free of waves, irregularities, or tool marks. Brooming with a fiber-bristle brush in a direction transverse to that of the traffic, followed by edging shall produce a scored surface.

E. Edge and Joint Finishing

1. Concrete sidewalk shall be cut into rectangular blocks approximately 5 feet long. The cut must extend at least 1/5 of the total thickness of concrete.

2. Concrete driveways shall be jointed in approximately square sections. The depth of the joint and the finishing of the edges shall be the same as for concrete sidewalk.

3. All slab edges, including those at formed joints, shall be finished with an edger having a radius of ¼- inch. Transverse joint shall be edged before brooming, and the brooming shall eliminate the flat surface left by the surface face of the edger. Corners and edges which have crumbled and areas which lack sufficient mortar for proper finishing shall be cleaned and filled solidly with a properly proportioned mortar mixture and then finished.

F. Surface and Thickness Tolerances

1. Finished surfaces shall not vary more than 5/16 inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to 1/4 inch.

3.05 SIDEWALK JOINTS

A. Sidewalk joints shall be constructed to divide the surface into rectangular areas. Transverse contraction joints shall be spaced at a distance equal to the sidewalk width or feet on centers, whichever is less, and shall be continuous across the slab. Longitudinal contraction joints shall be constructed along the centerline of all sidewalks 10 feet or more in width. Transverse expansion joints shall be installed at sidewalk returns and opposite expansion joints in adjoining curbs. Where the sidewalk is not in contact with the curb, transverse expansion joints shall be installed as indicated. Expansion joints shall be formed about structures and features, which project through or into the sidewalk pavement, using joint filler of the type, thickness, and width indicated.

B. Sidewalk Contraction Joints

1. The contraction joints shall be formed in the fresh concrete by cutting a groove in the top portion of the slab to a depth of at least one-fourth of the sidewalk slab thickness, using a jointer to cut the groove, or by sawing a groove in the hardened concrete with a power-driven saw, unless otherwise approved. Sawed joints shall be constructed by sawing a groove in the concrete with a 1/8-inch blade to the depth indicated. An ample supply of saw blades shall be available on the job before concrete placement is started, and at least one standby sawing unit in good working order shall be available at the jobsite at all times during the sawing operations.

C. Sidewalk Expansion Joints

1. Expansion joints shall be formed with 1/2-inch joint filler strips. Joint filler shall be placed with top edge 1/4 inch below the surface and shall

be held in place with steel pins or other devices to prevent warping of the filler during floating and finishing. Immediately after finishing operations are completed, joint edges shall be rounded with an edging tool having a radius of 1/8 inch, and concrete over the joint filler shall be removed. At the end of the curing period, expansion joints shall be cleaned and filled with joint sealant. Sealing material shall not be spilled on exposed surfaces of the concrete. Concrete at the joint shall be surface dry and atmospheric and concrete temperatures shall be above 50 degrees F at the time of application of joint sealing material. Excess material on exposed surfaces of the concrete shall be removed immediately and concrete surfaces cleaned.

D. Reinforcement Steel Placement

1. Reinforcement steel shall be accurately and securely fastened in place with suitable supports and ties before the concrete is placed.

3.07 SLOPE

A. Sidewalk cross slope shall be ¼-inch per foot unless otherwise noted in the drawings or requested by ENGINEER.

3.08 CURING

A. As soon after finishing operations as the free water has disappeared, the concrete surface shall be sealed by spraying on it a uniform coating of curing material in such a manner as to provide a continuous water impermeable film on the entire concrete surface.

B. The material shall be applied to form a uniform coverage at the rate of not less than one-half gallon per 100 square feet of surface area.

C. Within 30 minutes after the forms have been removed, the edges of the concrete shall be coated with the curing compound, applied at the same rate as on the finished surface.

3.09 PROTECTION OF CONCRETE

A. CONTRACTOR shall erect and maintain suitable barricades to protect the new concrete. Where it is necessary to provide for pedestrian traffic, CONTRACTOR shall, at his own cost, construct adequate crossings. Crossing construction shall be such that no load is transmitted to the new concrete.

B. Any part of the work damaged or vandalized prior to final acceptance shall be repaired or replaced at the expense of CONTRACTOR in a manner satisfactory to ENGINEER.

C. Pedestrian traffic shall not be permitted over new concrete prior to 72 hours after application of curing material. Vehicular traffic shall not be permitted over

newly placed concrete within seven days after completion when temperatures are 70°F or higher, 10 days when temperatures are not lower than 60°F and up to a maximum of 21 days when the temperatures are generally lower than 60°F.

3.10 SURFACE DEFICIENCIES AND CORRECTIONS

A. Thickness Deficiency

1. When measurements indicate that the completed concrete section is deficient in thickness by more than 1/4 inch the deficient section will be removed, between regularly scheduled joints, and replaced.

B. High Areas

1. In areas not meeting surface smoothness and plan grade requirements, high areas shall be reduced either by rubbing the freshly finished concrete with carborundum brick and water when the concrete is less than 36 hours old or by grinding the hardened concrete with an approved surface grinding machine after the concrete is 36 hours old or more. The area corrected by grinding the surface of the hardened concrete shall not exceed 5 percent of the area of any integral slab, and the depth of grinding shall not exceed 1/4 inch. Pavement areas requiring grade or surface smoothness corrections in excess of the limits specified above shall be removed and replaced.

C. Appearance

1. Exposed surfaces of the finished work will be inspected by the Owner and any deficiencies in appearance will be identified. Areas which exhibit excessive cracking, discoloration, form marks, or tool marks or which are otherwise inconsistent with the overall appearances of the work shall be removed and replaced.

END OF SECTION

SECTION 02675

DISINFECTION OF WATER SYSTEM AND WELL

PART 1 GENERAL

1.01 WORK INCLUDED

A. Disinfection of potable water distribution and transmission system and well.

B. Test and report results.

1.02 REFERENCES

A. ANSI/AWWA B300 - Standard for Hypochlorites.

B. ANSI/AWWA B301 - Standard for Liquid Chlorine.

C. ANSI/AWWA A100 - Standard for Water Wells.

D. ANSI/AWWA C601 - Standard for Disinfecting Water Mains.

E. ANSI/AWWA C654 - Standard for Disinfection of Wells.

1.03 QUALIFICATIONS

A. Water Treatment Firm: Certified for disinfecting potable water systems by chosen method; specializing in this work with 3 years documented experience.

B. Testing Laboratory: Certified for examination of drinking water in compliance with applicable legislation of the State of Pennsylvania.

1.04 REGULATORY REQUIREMENTS

A. Conform to applicable code or regulations for performing the work of this Section.

B. Provide certificate of compliance from Township including approval of water system.

1.05 SUBMITTALS

A. Submit under the provisions of Section 0l300.

B. Submit name of water treatment firm and evidence of qualification.

C. Submit name of testing laboratory and evidence of qualification.

D. Test Reports: Indicate results comparative to specified requirements.

E. Certificate: Certify that cleanliness of water distribution system meets or exceeds specified requirements.

1.06 QUALITY CONTROL

A. Provide testing and analysis of well and treated water under provisions of Section 01400.

B. Sample and test in accordance with AWWA C601 and AWWA C654.

1.07 PROJECT RECORD DOCUMENTS

A. Submit reports under provisions of Section 01400.

B. Disinfection report; accurately record:

1. Type and form of disinfectant used.
2. Date and time of disinfectant injection start and time of completion.
3. Test locations.
4. Initial and 24 hour disinfectant residuals (quantity in treated water) in ppm for each outlet tested.
5. Date and time of flushing start and completion.
6. Disinfectant residual after flushing in ppm for each outlet tested.

C. Bacteriological report; accurately record:

1. Date issued, project name, and testing laboratory name, address, and telephone number.
2. Time and date of water sample collection.
3. Name of person collecting samples.
4. Test locations.
5. Initial and 24 hour disinfectant residuals in ppm for each outlet tested.
6. Coliform bacteria test results for each outlet tested.
7. Certification that water conforms, or fails to conform, to bacterial standards of AWWA C601.
8. Bacteriologist's signature.

PART 2 PRODUCTS

2.01 DISINFECTION CHEMICALS

A. Chemicals: ANSI/AWWA B300, Hypochlorite, ANSI/AWWA B30l, Liquid Chlorine.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that well boring meets requirements of Section 11500 and AWWA A100 prior to well disinfection.

B. Verify that piping system has been cleaned, inspected, and pressure tested prior to piping system disinfection.

C. Coordinate beginning of treatment and disinfection activity with startup, testing, adjusting and balancing, and demonstration procedures of related systems.

3.02 WELL DISINFECTION

A. Drilling fluid shall be thinned in accordance with AWWA A100.

B. Gravel being installed in well shall be chlorinated in accordance with AWWA C654.

C. All permanent equipment and materials to be installed in well shall be chlorinated in accordance with AWWA C654.

D. After permanent equipment is installed, well shall be chlorinated in accordance with AWWA C654. Maintain contact time specified.

E. Pump the well to waste in accordance with AWWA C654.

F. Test for presence of coliform in accordance with AWWA C654.

G. Do not place well into service or connect to any lines until procedures are complete and accepted by Owner.

H. Well shall not be used for <u>any</u> service until backflow prevention device is installed between well and service point.

3.03 DISTRIBUTION AND TRANSMISSION SYSTEM DISINFECTION

A. Disinfect all distribution and transmission lines following the procedures outlined in AWWA C601.

B. Provide and attach equipment required to execute work of this Section in accordance with AWWA C601.

C. Inject treatment disinfectant into piping system in accordance with AWWA C601. Maintain disinfectant contact time specified.

D. Flush and clean with domestic water until required cleanliness is achieved.

E. Do not place system into service until procedures are complete and accepted by Owner. Owner must provide final authorization to use system and will operate all valves connected to existing system(s).

F. No part of system shall be used for any service until backflow prevention is installed at all service connections.

3.04 DISPOSAL OF CHLORINATED WATER

A. All water used for disinfecting shall be disposed of in an environmentally sound method and in accordance with State and local regulations.

END OF SECTION

SECTION 02731

RAW SEWAGE PUMP STATIONS

PART 1 GENERAL

A. All sewage pump stations shall be individually designed and equipped to meet the Township's specifications. Township and/or Engineer will determine if station is to be submersible type or wet well/ dry well type. Special site or system conditions precluding the use of the specified system shall be brought to the Engineer's attention as soon as possible.

B. All requirements of the Pa. Department of Environmental Protection Sewerage Manual shall be met except where they are exceeded by the Township's standards.

1.01 LOCATION

A. All sewage pump stations shall be located as far as possible from any existing or proposed dwellings to avoid potential odor/noise problems. A minimum of 200 feet should be maintained.

B. Safety of the public should be considered in selecting the location.

C. The station shall be visually screened from residences by the use of wooden fencing or landscaping. Final determination to be made by Township Landscape review consultant.

1.02 SIZING

A. The wet well shall be sized to minimize the time sewage is normally held to avoid septic conditions. Capacity shall, however, be provided to allow for at least one hour of holding capacity after the high-water alarm is actuated. (Not including storage in the collection system.)

1.03 ACCESS

A. All pump stations shall be accessible by a full-sized (24 feet length) service truck. Sufficient space for parking next to the station and for turning around shall be provided and access drive and parking area shall be paved.

PART 2 EQUIPMENT

A. Pumps installed in wet wells shall be non-clog submersible duplex electrical units equipped with sensors for heat and seal failure. They shall be capable of 20 starts per hour and continuous operation. Pumps installed in Dry wells shall be dry-well submersible, equivalent to Fairbanks Morse Model D5430W base-mounted submersible pumps.

B. Submersible pumps of 7-1/2 HP or less shall be manufactured Flygt. Pumps over 7-1/2 HP shall be Flygt and be equipped with flush valve system.

C. Check valves shall be weighted swing check variety. All check valves shall be supplied by the pump manufacturer or approved equal. All valves shall be in a separate vault and easily operable and serviceable from grade level.

D. Controls shall be supplied by the pump manufacturer or approved equal. When for a submersible pump station, they shall be housed in a stainless steel NEMA 4 enclosure equipped with a heater, fluorescent internal lighting and 24" overhang or equivalent to protect operator and controls from weather. Three-phase power shall be supplied. Whether in a submersible or dry-well station, the controls shall include, at a minimum, the following accessories:

1. Main Circuit Breaker
2. Swing Dead Front Panel
3. Lightning Suppressor
4. HOA manual switches, elapsed Time Meters, voltmeters and amp meters for each pump
5. 24-Hour Time Clock
6. Phase Failure Protection
7. Time Delay Lag Pump
8. Lead Pump Selector Switch
9. Manual Reset Heat Sensor
10. Pump Failure Indicator
11. Low Water Telemetry/Redundant Auto pump shutoff and alarm
12. High Water Telemetry and High Water Alarm
13. Seal Failure Contacts
14. Alarm Light
15. Raco Verbatim Auto phone dialer, completely wired and connected as directed by Township.
16. Power Failure Contacts
17. Anti-Condensation Heater

18. At least two convenience outlets

19. Intrinsically Safe Panels

20. Phase loss protection with auto reset (if three-phase pumps are provided)

E. An Emergency Portable Pump shall be supplied with each pump station. Each pump shall be gasoline driven mounted on skids or wheels depending upon the weight. Each pump shall have a self-priming capability. A suction hose with trash strainer shall be provided with each pump. A discharge hose and fittings to connect to three or four inch quick connect as directed by Township in the pump stations shall also be provided. Both the discharge hose and the suction hose shall be wire reinforced. All needed fittings for connections shall be brass and extend to grade level. Pumps shall be of high quality materials and easily started. The emergency pump shall be capable of continuous operation and shown to meet the flow and head conditions of each pump station. Pump shall be a Honda WX-30 or approved equal.

F. Access door shall be Type K as manufactured by the Bilco Company, New Haven, Connecticut or an approved equal. Door leaf shall be 1/4" aluminum diamond pattern plate to withstand a live load of 300 pounds per square foot. Channel frame shall be 1/4" aluminum with an anchor flange around the perimeter. Door(s) shall be equipped with heavy forged brass hinges, stainless steel pins, spring operators for easy operation, and an automatic hold-open are with release handle. A snap lock with removable handle shall be provided. A 1-1/2" drainage coupling shall be located in the front right corner of the channel frame. Hardware shall be stainless steel with bituminous coating applied to exterior of the frame. Installation shall be in accordance with manufacturer's instructions and be integrally cast with the concrete top slab. Manufacturer shall guarantee against defects in material or workmanship for a period of five years. They shall be equipped with hasps and locks.

G. Pump Station shall be fenced and gated as directed by Engineer and/or Township and be equipped with lighting sufficient to perform all routine and emergency maintenance. Lighting shall be pole-mounted and have both hand and photocell operation. Entire area inside fence shall be paved with asphalt as directed by Engineer and/or Owner. Depending on location, operator sanitary facilities shall be installed.

H. Pump station shall have it’s own potable water supply whether a well or connection to public water system with RPZ backflow preventer.

I. The Contractor shall furnish and install a pump mounting system for each pump station, which allows the pumps to be lowered into position easily without entering the wet or dry well. The mounting system shall consist of stainless steel rails to guide the pumps into position. They shall be secured to the concrete pump chamber at the bottom, top and braced every 15 feet. The support system shall be supplied by the pump manufacturer. A portable electric hoist capable of being operated by a single individual and have capacity to lift the pump clear of the wet well shall be supplied.

J. Station shall be equipped with either on-site or portable emergency generator and all associated hardware, transfer switch, etc. to make fully operable to Township specified transfer switch and outlet compatible with Township's standardized portable generator.

K. Wet well level sensor shall be multi-trode 2.2 or equivalent with all ancillary controls and equipment to sequence pump operation as instructed by Engineer.

L. Odor Control system of sodium hydroxide impregnated activated carbon in 55 gallon canister with air pump, silencer and permanent pvc or other approved connectors and stacks. This system shall be installed in its own attached lockable building or shed as approved by the Township and Engineer and be equipped with manual on/off switch at the canister and on the stations main electrical panel. Odor control system shall be manufactured by the Carbtrol Corporation or approved equal.

M. Station controls shall be fully SCADA compatible with system selected by Township.

PART 3 PUMP STATION CONSTRUCTION

A. All submersible pump stations shall be constructed of concrete per Section 03002.

B. All pump submersible stations shall be constructed with a separate valve chamber and be laid out using the Drawing in this section as a general guide.

C. All pump stations shall be designed to prevent flotation when empty and with the water table at the ground surface.

PART 4 TELEPHONE DIALER

A. A RACO Verbatim auto phone dialer unit shall be provided which will automatically call predetermined telephone numbers when any alarm condition is indicated at the alarm annunciation panel. The unit shall transmit a programmed message stating nature of the alarm condition. If the called number is busy, does not answer or if an incorrect number is reached, the unit shall hang up and call up to eight back-up numbers. Once the call is received, the person receiving it can acknowledge the unit from his telephone so that it will hang up and not place any more calls.

B. The unit shall monitor up to eight sets of normally open contacts, which can activate telephone numbers and voice message. Channel shall have built in AC monitoring circuitry so that if the AC power is lost to the station, the unit will automatically call out. There shall be a bypass switch so that this function can be bypassed and Channel used for other external alarms.

C. The unit shall have an adjustable (0-90 seconds) time delay to allow time for the operator to respond to the alarm. Also, a rechargeable battery unit shall be included to notify of AC power loss. The battery shall have sufficient capacity to supply six hours of calling after AC power failure.

D. Electrical:

1. Power Requirement 105-135 VAC, 15 watts maximum. Plug into dedicated receptacle.

2. Standby Battery: Gel Cell 6V, 2.6 A.H. Standby time 6 hours.

3. Battery Charging: Precision voltage controlled, including automatic rapid recharge after drain.

4. Input Sensing: Alarm on open contacts is standard, but each channel may be independently keyboard programmed for alarm on closed contacts or no alarm.

5. Surge Protection: Heavy-duty gas tubes followed by solid-state surge/transient protection on all inputs.

E. Dialing Format

1. Standard rotary pulse. FCC registered. Dials up to 8 different numbers.

2. Done by pressing a touch-tone "9" during alarm call, or by calling dialer back after alarm call is completed.

F. Program and Diagnostic Readout

1. Pressing a touch-tone "O" during any call causes user entered keyboard programming to be spoken over the phone.

G. Talk Through

1. If SPEAKER/MIC switch is left in MIC position, sounds picked up by the built-in microphone will be transmitted over the phone.

H. Keyboard Programming

1. The user enters up to 8 alarm dial-out phone numbers, local or long distance.

I. Acknowledged Alarm Conditions

1. Upon acknowledging any alarm condition by touch-tone or by callback (call-in following an alarm call-out), a time-out period (called "Alarm Reset Time") begins counting down. If the input circuit condition for that channel has not returned to normal before this time-out, the alarm will be reactivated and the dialer will begin placing alarm calls again. This "Alarm Reset Time" is normally one hour. However, the user may program any other "Alarm Reset Time" on the keyboard, up to 99 hours, or he may program "No Alarm Reset". The same "Alarm Reset Time" is common to all channels and also to Power Failure Alarm.

J. The Unit shall be factory wired and tested and be enclosed in a suitable steel enclosure within the panel. The unit shall be a Raco Verbatim or approved equal.

END OF SECTION

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SECTION 02732

BUILDING SEWERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Lateral piping, fittings, and accessories.

B. Connection of building sanitary drainage system to municipal sewers.

1.02 REGULATORY REQUIREMENTS

A. Conform to applicable Township, State Department of Environmental Protection and Department of Transportation code for materials and installation of the Work of this Section.

B. A building sewer permit is required from the Township prior to constructing any building sewer.

C. All local, state, and other laws and regulations governing blasting.

D. A road occupancy permit must be received from PennDOT (State owned roads) or Buckingham Township (Township owned roads).

1.03 SUBMITTALS

A. Submit shop drawings under provisions of Section 01300.

B. Submit shop drawings indicating dimensions, layout of piping, gradient of slope between corners and intersections, locations and elevations of manholes, and laterals.

C. Submit product data under provisions of Section 01300.

D. Submit product data for pipe, pipe accessories, and manholes.

E. Submit manufacturer's installation instructions under provisions of Section 01300.

1.04 PROJECT RECORD DOCUMENTS

A. Submit documents under provisions of Section 01410.

B. Accurately record location of pipe runs, connections, manholes, and invert elevations.

C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.05 QUALITY CONTROL

A. Inspection and testing shall be performed in accordance with Section 01400.

B. Prior to covering any portion of the Building Sewer, it must be inspected by the Township. All lines must be air tested to 4 PSI for 15 minutes or as otherwise stipulated in the Township's code, in the presence of the Township inspector. No work will be accepted unless it has been inspected and tested. All testing shall be per the pipe manufacturer's specifications.

1.06 NOTIFICATION OF ENGINEER AND TOWNSHIP

The Contractor must notify the Engineer at least 48 hours prior to beginning operation so that an Observer can be scheduled to be present. Engineer will inspect from the sewer main up to the property line or edge of right of way. The township will inspect from where the engineer stops inspection up to and including the building to be served. Under no condition are operations to commence without this notification and an Observer present.

PART 2 PRODUCTS

2.01 PIPE MATERIALS

A. Ductile Iron Pipe (DIP)

Ductile iron sewer pipe and ductile iron pipe shall be centrifugally cast pipe with cement mortar lining and with bitumastic coating inside and outside. Joints shall conform with ANSI Specification A-21.11 Class 52. Pipes shall be laid in accordance with the Manufacturer's recommendations.

B. Polyvinyl Chloride

Sewer pipe (20' maximum length) shall meet extra strength minimum SDR-26 requirements of ASTM Specification D-3034-74. Pipe shall have integral wall, bell, and spigot joints with elastomeric gasket. All fittings and accessories shall be SDR-35 and shall be manufactured by the pipe supplier. Maximum allowable deflection after installation shall be 5%. Installation shall be in accordance with ASTM D-2321, "Underground Installation of Flexible Thermoplastic Sewer Pipe", and as specified herein.

2.02 PIPE ACCESSORIES

A. *Fittings:* Same material as pipe, molded or formed to suit pipe size and end design, in required 'T', bends, elbows, clean-outs, reducers, traps, and other configurations required.

B. *Pipe Saddles:* Pipe saddles are only to be used when connecting into an existing line where a wye has not been installed. These wyes shall be Sealtite Type "E" Multi-Range Wye Sewer Saddle manufactured by The General Engineering Company (GENECO) or approved equal.

PART 3 EXECUTION

3.01 GENERAL

A. All pipe shall be unloaded, handled and stored in conformance with the manufacturer's recommendations.

B. Pipes shall be laid at a grade not less than 1/4 inch per foot (2.08%) unless a lesser grade is approved by the Engineer. Each section of pipe shall rest upon the pipe bed for the full length of its barrel, with recesses excavated to accommodate bells and joints. Any pipe, which has its grade or joints, disturbed after lying shall be taken up and relaid. Pipe sections shall be inspected, and the interior and ends of all pipe shall be cleaned before lowered into the trench. During construction, the Contractor shall use all precautions to keep the pipe clean and clear of debris and free from damage until finally inspected and accepted. The mouth of the completed sewer pipe shall be properly closed at all times with an expanded rubber plug or other approved device, except when pipe lying is in progress.

C. Pipe laying shall be done only in the presence of an Observer. The Contractor shall notify the Engineer at least 48 hours prior to beginning pipe laying and the Township as provided for in the permit.

D. When necessary to cut pipe to size, it shall be done by saw cutting, neatly and cleanly.

E. Bedding and laying of pipe shall be in accordance with the pipe manufacturer's recommendations. Pipe joints shall be made in accordance with the joint manufacturer's recommendations.

F. Regardless of its material, all pipe shall be laid on a minimum six-inch (6") thickness of AASHTO No. 67 stone as approved by the Engineer.

G. If the house sewer is not to be connected immediately to the lateral, the lateral pipe stub shall be capped with a watertight pressure type fitting capable of withstanding the exfiltration tests and is to remain until future connection to the house sewer. The ends of all laterals not immediately connected to the house sewer shall be physically marked to show location and depth of pipe end. Method of marking to be a 1" x 3" board extending from the end of the lateral to a height of 12" above grade. Depth of lateral is to be marked with a waterproof felt-tipped marking pen on that portion extending above grade. Contractor is responsible for the maintenance of the marker.

H. Laterals shall be of the same type of material as the sewer line to which the lateral connects unless otherwise approved by the Engineer.

I. Laterals shall not be installed directly from a manhole unless written approval is received from the Engineer.

3.02 EXCAVATION

A. Existing road surfaces are to be neatly cut along edges of the proposed trench prior to excavation.

B. Extreme care is required when excavating to expose the existing sewer main. To prevent damage to the main sewer line, machine excavation shall be terminated and hand excavation begun within a radius of two feet of the main sewer line.

C. Trenches shall be dug to depths and widths as specified herein or as approved by the Engineer. Sides of trenches shall be nearly vertical as possible.

D. Trenches shall be excavated true to line so that a clear space of eight (8) inches, no more, is provided on each side of the pipe bell to a height not less than the top of the pipe. These dimensions are applicable to the inside face of sheeting, if such is required at the elevation of the pipe. Trenches may be wider above the top of pipe.

E. When the width below top exceeds bell plus 16 inches, the Engineer may call for stronger pipe at no expense to Township.

F. Where a section of trench has, by the Contractors own mistake, been excavated to a greater depth than specified, it shall be brought to the proper grade using AASHTO No. 67 crushed stoned.

3.03 TRENCH DEWATERING

A. Maintain excavations free of water. Water removed from excavations shall be disposed of in such a manner as to prevent damage to public or private property, or to any portion of the work completed or in progress. ***In no case shall water be permitted to rise into or flow through a completed sewer unless written permission is obtained from the Township.***

3.04 PIPE INSTALLATION

A. All laying, jointing, testing for defects and for leakage shall be performed in the presence of the Engineer. All defects in workmanship rejected by the Engineer shall be promptly corrected by the Contractor and defective material removed from the Project.

B. The excavation in which pipe is being laid shall be kept free from water, and no joint shall be made under water. Care shall be used to secure water-tightness and to prevent damage to, or the disturbing of, the joints during the backfilling process or at any other time. After pipes have been laid and the joints have been made, there shall be no walking on or working over them except as may be necessary in tamping until there is a covering at least two (2) feet in depth over their top. After joint materials, which require it, have received their set, backfilling of the trench may proceed in the manner specified.

C. Before joints are made, each pipe shall be well bedded on a solid foundation and no pipe shall be brought into position until the preceding length has been thoroughly embedded and secured in place. No pipe shall be laid in wet trench conditions that preclude proper bedding, or on a frozen trench bottom, or when in the opinion of the Engineer, the trench or weather conditions are unsuitable for proper installation. Any defects due to settlement shall be corrected by the Contractor at his own expense. Bell holes or coupling holes shall be dug sufficiently large to insure making of proper joints. In no case will pipe be closer than four (4) inches from bedrock.

D. In laying pipe, special care shall be taken to insure that each length shall abut against the next in such a manner that there shall be no shoulder or unevenness of any kind along the inside of the pipe line.

E. No wedging or blocking will be permitted in laying pipe unless by written order from the Engineer.

F. Pipes and fittings shall be thoroughly cleaned before they are laid and shall be kept clean until the acceptance of the completed Work. The open end shall be kept closed with a stopper until the next length is laid. At the close of work each day, the end of the pipe line shall be tightly closed with an expansion stopper so that no dirt or other foreign substances may enter the line, and this stopper shall be kept in place until pipe laying is again resumed.

G. Cold weather protection shall be provided, during freezing weather, for all masonry, mortar and concrete construction connected with the exterior piping by maintaining a temperature of not less than 50°F. for a period of three (3) days, or by backfilling immediately, or by covering with backfill material in a temporary manner, all as directed by the Engineer.

H. All open ends of pipelines to be abandoned, exposed during construction operations shall have their openings plugged with a two-(2) foot minimum thickness of concrete.

I. All dead-ends of pipelines, and fittings, shall be provided with standard plugs and caps either temporarily or permanently as directed by the Engineer. A concrete or other approved thrust blocking shall be provided at all dead ends. Where plugged or capped outlets are to be tied to fittings with clamps and tie rods, as indicated on the Contract Documents or as directed by the Engineer, the minimum number and size of rods and other pertinent details shall be as shown and/or specified.

J. Anchorage, buttresses, and thrust blocks shall be used to secure all caps, plugs, horizontal and vertical bends, branches, tees, and dead ends. They shall be constructed in accordance with the Standard Details, unless otherwise specified, and shall bear against solid, undisturbed earth.

3.05 INSTALLATION OF A SADDLE WYE FITTING

A. Regardless of the combination of materials used installing a lateral to sewer main (PVC, or DIP), saddle Wye fitting shall be manufactured by The General Engineering Company (GENECO), Frederick, Maryland.

B. On PVC pipe, installation shall be according to the following guidelines:

1. Place saddle in position on pipe for use as a template and mark guide for hole cut-in. Remove saddle from pipe. If a separate template is supplied with the saddle Wye, use it for a guide.

2. Using hole guide mark cut hole through pipe wall outside the hole guide mark by the thickness of the saddle stem. The diameter of the hole should not exceed the outside diameter of the saddle stem by more than 1/4". Use a hand keyhole saw or power saber saw to cut the hole. For most saber saws with heavy-duty blades, the blade should be held horizontally across the pipe and pressed downward until it penetrates the pipe wall. The blade can then be brought to the vertical position and the hole cut completed. Cut or bevel the downstream end of the hole at a 45 angle to allow the saddle stem to fit.

3. Wipe clean and dry both the underside of the saddle and the mating surfaces of the pipe.

4. Position saddle over the hole. Place the stainless steel strap around the pipe and connect with nuts and bolts provided by manufacturer.

5. Tighten strap until the recommended torque has been reached by hand. The minimum torque applied should be 5 ft. - lbs.

6. H.E.S. concrete shall then be manually placed around the saddle and sewer main, then rodded and brought back up to the spring line to provide continuous support for both.

Note: If saddles are not properly positioned, the rubber gasket may not be touching the pipe, possibly resulting in a leak.

3.06 BACKFILL

A. Ductile Iron Pipe

1. The procedure for backfilling ductile iron sewer pipe shall be as follows: After the sewers have been installed, the material directly around the pipe shall be hand tamped. Then, in such manner as not to disturb the pipe, backfill to a height of twelve (12) inches above the top of the pipe, and compact with a mechanical tamper. The remainder of the trench shall be backfilled by one of the following methods:

   a. When the pipeline is located within a State Highway, Township road, parking lot or other roadway area, the trench shall be backfilled in layers not exceeding six (6) inches in thickness and mechanically tamped.

   b. When the pipeline is located beneath an unpaved area, or area not subject to vehicular traffic, backfilling may be accomplished by filling to the ground surface in one operation and compacting by trench roller or special heavy-duty tamping machine. The backfill material may be deposited in the trench by the excavating equipment or a front-end loader from the end of the trench. Excavated material free of large stones, (stones greater than three (3) inches in any direction) may be used for this backfill.

   c. When the sewer is located within an existing Pennsylvania State Highway, Township Street or road, parking lot or other roadway area, the trench shall be backfilled with compacted 2RC stone.

2. Backfilling material, placed within two (2) feet of manholes and other structures, shall be deposited uniformly around the sides in layers not exceeding eight (8) inches in depth, and solidly tamped in such a manner as to avoid impairing the structures or producing unequal pressure on them.

B. PVC Pipe

1. The procedure for backfilling PVC sewer pipe shall be as follows: After the sewers have been installed on a firm bedding as shown on the standard detail, haunching material shall be carefully placed and consolidated under the pipe haunch to provide

adequate side support. The haunching material shall be placed in four (4) inch compacted layers to the tope of the pipe. The material shall be placed in such a manner as not to disturb the pipe. The haunch material shall be AASHTO No. 57 stone.

2. An eight-(8) inch layer of AASHTO No. 57 or 2RC stone backfill shall be placed above the spring line of the pipe to provide a protective cushion.

3. The remainder of the trench shall be backfilled by one of the following methods:

   a. When the pipeline is located within a State Highway, Township road, parking lot or other roadway area, the trench shall be backfilled in layers of 2RC stone not exceeding six (6) inches in thickness and mechanically tamped.

   b. When the pipeline is located beneath an unpaved area, or area not subject to vehicular traffic, backfilling may be accomplished by filling to the ground surface in one operation and compacting by trench roller or special heavy-duty tamping machine. The backfill material may be deposited in the trench by the excavating equipment or a front-end loader from the end of the trench. Excavated material free of large stones (stones greater than three (3) inches in any direction) may be used for this backfill.

   c. When the sewer is located within an existing Pennsylvania State Highway, Township Street or road, parking lot or other roadway area, the trench shall be backfilled with compacted 2RC stone.

2. Backfilling material, placed within two (2) feet of manholes and other structures, shall be deposited uniformly around the sides in layers not exceeding eight (8) inches in depth, and solidly tamped in such a manner as to avoid impairing the structures or producing unequal pressures on them.

3.07 EXISTING SEPTIC SYSTEM ABANDONMENT

A. All existing septic tanks, grease traps, cisterns, manholes or any other on-site treatment system component shall be abandoned after connection to the sewage system. All underground tanks including septic, pump, cisterns, seepage pits and cesspools shall have all liquid and sludge removed from them. After these tanks have been cleaned, the entire top shall be collapsed or removed and they shall be filled with compacted soil, stone or other suitable material in the presence of a township inspector or Engineer. The drain field piping does not have to be removed or filled unless the property owner wishes to do so.

3.08 GREASE TRAPS

A. Grease, oil and sand interceptors shall be provided when, in the opinion of the Township, they are necessary for the proper handling of liquid wastes containing floatable grease in excessive amounts, sand, or other harmful ingredients, except that such interceptors shall not be required for private living quarters or dwelling units. All interceptors shall be of a type and capacity approved by the Township, and shall be located as to be readily and easily accessible for cleaning and inspection. In the maintaining of these interceptors the owner(s) shall be responsible for the proper removal and disposal by appropriate means of the

captured material and shall maintain records of the dates, and means of disposal, which are subject to review by the Township. Any removal and hauling of the collected materials must be performed by currently licensed waste disposal firms.

B. Generally, only restaurants or other food handling facilities require grease traps. Since the type and size of grease traps will vary based on the volume of grease expected, the proposed grease trap design must be submitted to the Township for approval at the time the application is made for connection to the sewer system.

END OF SECTION

SECTION 02733

WASTEWATER TREATMENT FACILITIES

PART 1. GENERAL

A. All wastewater treatment facilities to be owned and/or operated by Buckingham Township shall be individually designed and equipped to meet the Township's specifications. Special site or system conditions precluding the use of the specified system or equipment shall be brought to the Engineer's attention as soon as possible. Treatment techniques and, therefore, plant type shall be determined through the Township's Act 537 selection directions, planning module reviews and/or by negotiation with Township.

B. All requirements of the Department of Environmental Protection Sewerage Manual shall be met except where they are exceeded by the Township's standards.

C. Related sections: 02224. 02226, 02227 and 02228.

1.01 LOCATION

A. All wastewater treatment facilities shall be located as far as possible from any existing or proposed dwellings to avoid potential odor problems. A minimum of 600 feet should be maintained from primary lagoons, pump station outfalls and mechanical plants.

B. Safety of the public should be considered in selecting the location.

C. The facility shall be visually screened from residences by the use of wooden fencing or landscaping. Landscaping needs will be site-specific and determined by the township's landscape consultant within the context of buffers required by the Pa. DEP.

1.02 SIZING

A. The treatment facility and all of its components shall be sized based on an average daily flow as determined in the Township's Wastewater Planning Volumes for Small Developments up to 150 homes. Thereafter, a minimum volume of 262.5 gpd per EDU shall be used for three and under bedrooms. Four bedrooms EDU = 300 gpd and 5 bedrooms EDU = 325 gpd. Greater than 5 bedrooms requires 25 gpd/bedroom. Peak daily flows shall be two and a half (2.5) times the average. Facilities designed to serve other than single-family residences shall be designed based on DEP guidelines in Chapter 73 of their Rates and Regulations.

1.03 ACCESS

A. All treatment facilities shall be accessible by a full size semi-trailer truck with 5 axles and maximum Penn DOT GVW. Sufficient space for parking as determined by Township shall be provided and access drive and parking area shall be paved to support anticipated loading. Impervious surface regulations shall strictly apply.

B. Chain Link fencing of all mechanical treatment plants shall be required to protect it and the public. Fencing requirements shall be per Section 02831. Fencing of lagoon treatment plants with spray or other irrigation shall be standard 3-rail and post systems of lumber

treated to last 50 years. Lagoons and buildings shall be fenced with chain link systems to protect facilities and public. No trespassing signs shall be posted every 100 feet on perimeter fences and every 50 feet on lagoon/mechanical plant fences.

PART 2 EQUIPMENT

A. Aeration, Settling, Sludge Holding, Chlorine Contact, Equalization and other treatment, holding or valve tanks.

1. All tanks shall be constructed of reinforced concrete under the provisions of Section 03001 or 03002 of these specifications.

2. The tanks shall be protected from floatation and flooding.

3. They shall be designed with sufficient freeboard to prevent over-topping.

4. If the tanks are set within 3-0' of ground level, they shall be covered with grates or surrounded with railing (Section 05520 or 05530.)

5. All tanks shall be fully and easily accessible by operating personnel for equipment maintenance.

6. Dewatering sumps shall be provided in all sludge tanks, chlorine contact tanks and other tanks that require periodic cleaning or sludge removal. Pumps for dewatering, whether in-place or portable, shall be provided along with enough suction and discharge hose or piping to safely and efficiently dewater the tank(s).

B. Aeration Equipment

1. Blowers shall be of the rotary lobe, positive displacement type and shall be redundant.

2. They shall include intake filters with silencer, discharge silencer, vibration isolator, pressure gauge and pressure release valve.

3. The blowers shall not exceed 85dBA decibels within the room they are located.

4. The blowers shall be housed in a separate portion of the operations building away from the normal work area for the operator. The blower room shall be forced-air ventilated to reduce heat buildup and walls shall be sound insulated to reduce noise outside the room to less than 55 decibels.

5. The blowers shall be manufactured by Dresser Industries, Roots Division or approved equal.

6. The blowers shall be driven by three phase electric motors when possible and controlled by a 24-hour timer and normal operating switches. Blowers shall be equipped with variable frequency controls as approved by Engineer.

7. Diffusers shall be fine-bubble or as otherwise directed by Engineer and be removable without dewatering the tanks. They shall be equipped with double check valves and be manufactured by Wyss (Parkinson Corp.) or approved equal. Spare diffusers shall be provided (110% of total needed).

8. All piping for submerged air distribution shall be 316 stainless steel.

9. Lagoon aerators shall be manufactured by Aqua-aerobic, Inc. and be equipped with heat blankets or, alternatively with approval of Township, heat shields. Construction material shall be stainless steel throughout.

C. Pumps

1. Influent lift pump stations shall meet the requirements of Section 02731.

2. All other pumps shall be sized and selected to meet the requirements of the material to be pumped and shall be selected to avoid clogging, be easily accessible, and have provisions for backup operations if critical to the day to day operation of the plant.

3. Acceptable manufacturers shall include Flygt, Fairbanks Morse or approved equal.

4. Non-submersible pumps shall be provided with drains for packing boxes, if required however, mechanical seals are preferred for most applications.

5. Township requires variable frequency motor controls or other suitable flow matching equipment.

6. All pumps shall be equipped with isolatable check valves. Externally-weighted swing checks are preferred for most applications. Ball checks may be substituted only with approval of Township and Engineer.

D. Emergency Power

1. An emergency electrical generator capable of operating all essential plant equipment on a temporary basis shall be provided. Equipment to be operated included influent pumps, disinfection equipment, blowers, lights, and other pumps required to prevent the discharge of untreated wastewater.

2. The emergency generator shall be capable of all weather starts and housed in a weatherproof enclosure.

3. Caterpillar and Kohler are acceptable manufacturers.

4. Generator shall be equipped with automatic starting controls, a residential type silencer on the exhaust, jacket water heater and be provided with automatic shut-offs for high temperature, low oil pressure, overspeed and engine overcrank.. Alarm shall be transmitted to Autodialer for all generator fail conditions. Fuel shall be as determined by Township and Engineer to provide the best long-term operating economy.

E. Filtration Equipment

1. Sand filters shall be required either as an integral part of any mechanical treatment process or as a safety measure to prevent unacceptable discharges to the stream in the event of plant upsets or equipment failures.

2. The filters shall be of the intermittent sand type or continuous flow automatic backwash.

3. Acceptable manufacturers include Parkson Corporation (Dyna Sand), and Aqua Aerobics.

4. The filters shall be weatherized to allow for year-round operation.

F. Lagoons

1. General

The Township requires all wastewater treatment lagoons to be constructed with a geomembrane liner installed according to specification 02224. There may arise occasions where, in the sole determination of Township and Engineer, a bentonite liner is preferred or is required **in addition to** the geomembrane liner (such as in limestone areas). Bentonite mat liners are preferred over bentonite-amended soil. Bentinite mat liner system installations are covered under section 02226 of these specifications. The purpose and scope of this specification is to cover the general construction of wastewater lagoons with a liner having permeability of $1x10^{-8}$ cm/sec or less. Reference in this specification to bentonite liners is to bentonite-amended soil liners which will rarely, if ever, be required.

a. Wastewater treatment lagoons used prior to land application shall be of the aerated/facultative type. A minimum of three aerated lagoons shall be constructed – all piped so that any two may be operated independent of the third.

b. The primary aerated pond shall be designed with a K value of 0.06 (22 days retention time).

c. The facultative pond shall be designed with a loading rate of 20 lbs. of BOD per acre per day.

d. Depending upon the spray irrigation system, a minimum of 100 days storage shall be provided.

e. Because of varying soil conditions, extreme caution is needed in preliminary site testing, design, and construction. A pre-design conference with the Township's Engineer is required to review site conditions and the proposed design concept.

f. The Contractor shall furnish all material and labor, and perform all work necessary to construct sewage treatment lagoons as hereinafter specified or as specified in 02224, and required by the design engineer and approved by Engineer. Modifications to the procedure outlined below may be required depending upon the results of the field and laboratory tests described below. In any event, the Contractor shall employ whatever

construction, placement and compaction procedures deemed necessary by the Engineer.

g. The Contractor shall submit evidence to the Engineer that he is competent to construct the specified liner. This evidence shall insure that the Contractor or his subcontractor has sufficient competent personnel to carry out the specified operations.

2. Type of Equipment for Lagoon Construction

a. The Contractor shall use compaction equipment compatible with the types of materials being placed. In general, sheepsfoot or rubber-tired rollers shall be used to compact cohesive soils and smooth-wheeled vibratory rollers shall be used to compact granular materials. However, sheepsfoot rollers shall not be used to compact a soil-bentonite liner. It may be necessary to use a compactor with small pads, such as a Rascal 320-A as manufactured by RayGO, in combination with a smooth-wheeled roller. Contractor shall provide Engineer with a list of all equipment to be used in the lagoon construction and lining. Engineer will approve list and return to contractor with any other required equipment.

3. Construction procedures

a. Initial lagoon site preparation shall consist of the stripping of all topsoil, vegetation, and organic material from the entire area of construction. This material shall be stockpiled in a location to be determined at the time of construction for future use in the project.

b. If a bentonite liner is to be installed, under direction of the Engineer, the Contractor will take soil samples from stockpiled lagoon liner material, to be tested by American Colloid to verify the bentonite application rate before ordering the bentonite. If the test results indicate a lower application rate than as specified in the Contract Documents, the higher of the two application rates should be used.

c. Lagoon Site: The exposed embankment sub-grade and lagoon bottom sub-grade areas shall be proof-rolled with at least four passes with a large (greater than five tons) smooth-wheeled roller or other approved construction equipment. The sub-grade shall be compacted to a minimum density equivalent to 95 percent to the maximum dry density as determined by the Standard Proctor Test (ASTM D698). The moisture content at the time of compaction shall not vary from the optimum moisture content by more than three percentage points. Soft or organic areas detected during sub-grade preparation shall be over-excavated and backfilled with compacted fill in accordance with Item C. Any signs of sinkholes shall immediately be brought to the Engineer's attention.

d. The on-site excavated low plasticity silt and clay materials (ML, ML-CL and CL) excluding topsoil, ice and frozen materials; containing less than 30 percent gravel; and a maximum particle size of 4 inches shall be utilized for construction of the lagoon embankments. The soil descriptions are in accordance with ASTM D2487. These materials shall be placed in uniform, horizontal, eight (8) inch loose lifts and compacted to at least 95 percent of the maximum dry density as determined by the Standard Proctor Test. The moisture content at the time of compaction shall not vary from the optimum moisture by more than three percentage points.

e. If borrow material is required for completion of the embankments, these soils shall conform to the requirements for clay material (ML-CL or CL) as defined by the Unified Soil Classification system (ASTM D2487). Laboratory verification of conformance shall be obtained before placement of these materials.

f. The lagoon bottoms and side slopes beneath the liner shall be compacted to at least 92 percent of the maximum dry density, as determined by the Standard Proctor Test, prior to placing any soil to be mixed with bentonite. The moisture content at the time of compaction shall not vary from the optimum moisture by more than three percentage points.

g. If a soil-bentonite liner is to be used in the lagoons, the soil used shall consist of the low plasticity silt and clay material excavated during construction or an approved equivalent (Unified Classification ML, CL, or ML-CL in accordance with ASTM D4318). All rock fragments equal to or larger than one inch in size shall be removed. The maximum amount of gravel (particles retained on the No. 4 Sieve) shall be twenty percent or less by weight and the percent fines (material passing the No. 200 Sieve) shall be 60 percent or more by weight, in accordance with ASTM D422. The Contractor shall be responsible for segregating soil that meets these requirements.

h. The lagoon bottoms and banks shall be lined in a sequence of operations, which minimizes risks of damage or delay due to rainfall. Bentonite shall not be placed unless there is a reasonable chance of completing the mixing and blending operations prior to the occurrence of rain. Any erosion of the liner shall be repaired by placing a new four-inch liner over the affected areas.

i. The compacted liner and cover materials shall be covered with fresh water, as soon as possible. Means shall be taken to insure that when the lagoons are filled with water that no erosion occurs to the liner or cover materials. All unflooded areas shall be kept moistened so as to prevent the soil from drying out or cracking. Any portion of the liner damaged by

drying shall be repaired by placing a new four-inch liner over the affected areas.

j. Pure bentonite (Volclay SG-40) shall be hand applied and hand compacted up along the edges of all construction appurtenances for a minimum distance of two inches away from the appurtenances for the entire depth of the liner.

k. The compacted soil placed on the lagoon bottom above the soil-bentonite liner shall be in accordance with Items C and D. The soil-bentonite liner shall not be damaged while placing the compacted soil on top of it.

l. The geotextile placed beneath the PA #4 stone shall be GTF-225D as manufactured by Exxon of Atlanta, Georgia or approved equal. The adjacent sheets of the geotextile shall be sewn together using a double chain-type stitch. The geotextile shall be placed with the long dimension parallel with the slope direction (up and down the slope). Backfilling operations shall be performed in a manner which prevents damage to the geotextile and the soil-bentonite liner.

m. Immediately upon completion of the lagoon liner and acceptance by the Engineer, the Contractor shall fill the lagoons with fresh water to allow the soil-bentonite liner to swell and seal. The soil-bentonite liner shall be kept moist at all times.

n. The bentonite shall be covered by the manufacturer's warranty against defects in material or workmanship. It shall have a useful life of 30 years under normal weathering and normal use conditions.

o. The Contractor shall place four (4) inches of topsoil over all embankments prior to seeding and mulching.

G. Operations Manual

1. The Contractor shall provide four (4) sets of instruction booklets for all equipment including but not limited to the motors, pumps, flow meter, activated sludge equipment, sprinklers, control equipment, electrical equipment and chlorinators. Each complete set shall be placed in a high-quality three ring binder.

2. These instruction booklets shall be in durable binding and shall include the following:

a. Summary sheet of maintenance required including lubrication schedule.

b. Technical data and parts list for all components

c. Schematic drawing of electrical service

d. Approved shop drawings

e. Section for "Notes"

f. Operations Instructions and Procedures

g. As- built drawings.

h. Any special safety concerns.

3. These booklets are to be delivered prior to any operation of the equipment.

H. Start-up

1. Prior to accepting wastewater, all components of the plant shall be tested with water. All pumps, blowers, alarms and emergency equipment shall be run and tested to determine if they meet the specifications.

2. Piping shall be tested per Section 15400.

I. Disinfection

1. Disinfection equipment shall be of the Ultraviolet disinfection type where discharges are made to small streams. Liquid Sodium Hypochlorite systems with applicable de-chlorination facilities may be approved in the sole discretion of Township and Engineer. Sodium Hypochlorite disinfection equipment shall be contained in a separate well-insulated building with interior walls lined or constructed of HDPE sheeting. Construction materials shall be determined by Township and Engineer but must be chemically resistant throughout. Chlorine building shall have, at a minimum, hot and cold running water, slop sink, 3ft. x 6 feet work countertop of HDPE or other chlorine resistant material, dual tanks and pumps for each discharge point and constructed in place storage shelving no less that 5 shelves and 3feet wide x 2 feet deep x 6 feet tall. Chemical feed pumps shall be LMI (as manufactured by Milton Roy Corp.) for the application and flow range needed. Design dosage shall be at pump settings 50/50.

J. Control Building

1. A building shall be provided to house the controls, blowers and other necessary equipment including portable pumps, generators, mowing and other landscape equipment.

2. It shall be provided with a separate operator room, which may not contain the electrical controls or major mechanical equipment. The operator's room must contain at least 40 square feet of chemical resistant counter space, a lab sink and a separate bench for working on mechanical equipment. Potable water from a reliable source shall be provided. Functional floor drains are required in all areas that could be wetted.

3. It shall provide enough storage space in cabinets for all laboratory equipment and supplies and all tools. Storage shall be in operator’s room or other location in the building as directed by Township.

4. The building shall be insulated to current standards and provided with an automatic heating and cooling system. Skylights doors and windows shall be

specified at time of plan review and shall conform to acceptable industry standards for the use intended.

5. A separate bathroom equipped with sink, shower toilet and floor drain is required.

6. Control buildings for treatment facilities with flows above 75,000 gpd may require additional facilities such as greater laboratory and equipment storage space.

K. Sludge Processing

1. All sludge shall be processed to allow for its disposal at a licensed sanitary landfill. The processing equipment must be able to dry the sludge consistently to above Twenty Five percent (25%) solids and be housed in an isolated, odor-controlled building.

2. Sufficient isolated and odor-controlled storage space shall be provided to store the sludge in either a liquid or processed state to allow for cost effective processing or transportation of the material.

3. Those facilities with flows under 75,000 gallons per day shall be reviewed to determine if the sludge should be transported to another facility for processing. A cash contribution in lieu of constructing sludge processing facilities at the smaller plant may be an acceptable alternative.

L. Miscellaneous Equipment

1. Laboratory supplies shall include all necessary automatic samplers, glassware, oxygen and pH meters, ovens, incubators, test kits and miscellaneous hardware and chemicals to perform all NPDES permit sampling and analyses required of the specific treatment system and plant.

2. Mowing and site maintenance equipment such as gators, backhoes, tractors, chain saws and the like shall be provided to fit both the sites landscape maintenance needs and the site's crop management plan, if any.

3. Boats as required to maintain lagoon aerators.

4. Fire Fighting Equipment - fire extinguishers shall be of the following type:

   a. ABC Dry Chemical: 20 lbs. capacity, enameled steel container with pressure-indicating gauge, for Classes A, B, and C fires.

   b. The fire extinguishers shall be as manufactured by W.D. Allen Co., Casco Products Corp., General Fire Extinguisher Corp., or approved equal.

   c. An extinguisher shall be located in each room of the control building and with each piece of mowing equipment if larger than a garden tractor

M. Flow Equalization shall be provided for in all treatment facilities.

END OF SECTION

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SECTION 02734

SEWAGE GRINDER PUMP SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. The work covered by this section includes furnishing all labor, equipment and materials required to install and test grinder pump station(s), each consisting of a basin package, control panel, alarm device, unitized level control system, grinder pump and all necessary appurtenances to form a complete U.L. listed package system. Grinder pump shall be listed to U.L. 778 and CSA 108, basin package shall be listed to U.L. 1951, and control panel shall be listed to U.L. 508. All equipment in the wet well shall be capable of constant submergence in sewage to a minimum depth of ten feet without electrical power being energized.

1.02 REGULATORY REQUIREMENTS

A. Conform to applicable Township, State Department of Environmental Protection and Department of Transportation code for materials and installation of the Work of this Section.

B. A building sewer permit is required from the Township prior to constructing any building sewer.

C. All local, state, and other laws and regulations governing blasting.

D. A road occupancy permit must be received from PennDOT (State owned roads) or Buckingham Township (Township owned roads).

1.03 SUBMITTALS

A. The Contractor shall provide a construction plan showing the location of property, tax parcel number, pump capacity curve together with total dynamic head curve superimposed thereon, connection details, plan and profile view of force main, grinder pump station, house and pertinent topographic features, and location of controller.

B. Contractor shall submit complete detailed equipment, hydraulic, pneumatic, and electrical diagrams and a functional description of the completely integrated sewage pumping system, as indicated on the Drawings and described herein.

Information shall include but not be limited to:

1. Complete detailed equipment, hydraulic and control diagrams, ventilation, electrical diagrams, and specifications.

2. Dimensions of fiberglass containment basin.

3. Pump data including certified pump efficiency flow and horsepower curves.

4. Complete sectional detail drawings showing the placement of all equipment.

5. Complete and accurate plans and schematics for all electrical and mechanical equipment.

6. Clear and concise instructions for installation, alignment and adjustment of machinery.

7. Instructions for operating equipment under all design conditions.

8. Lubrication, maintenance, and trouble-shooting instructions complete with necessary diagrams and schematics.

9. Complete parts list with exploded schematics.

10. Complete wiring schematics for motors, motor controls, and other electrical components supplied with the pump systems, including interface details of the motor control system starting equipment, wet well sensing and control system, and alarm sensor.

1.05 PROJECT RECORD DOCUMENTS

A. Accurately record location of pipe runs, connections, pump stations, and invert elevations.

B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.06 QUALITY ASSURANCE

A. All pumping equipment, pipe, valves, and fittings furnished under this section shall be new, unused, and the manufacturer's current production model. Unit must conform to the best practice known to the trade in design, quality of material, and workmanship. Assemblies, subassemblies, and component parts shall be standard and completely interchangeable. The equipment must conform to all applicable federal state, and local regulations.

B. At the Engineer's request, the Contractor shall furnish a certificate from the manufacturer of the pipe and fittings that the manufacturer is completely competent and capable of manufacturing PVC pipe and fittings of uniform texture and strength to fully comply with these specifications and has manufactured such pipe in sufficient quantities to meet all normal construction requirements. The manufacturer must have adequate equipment and quality control facilities to be sure that such extrusion of pipe is uniform in texture, dimensions, and strength. All pipe shall be tested at the place of manufacture for all requirements of the latest ASTM and commercial Standard tests, and prior to the laying of the pipe, certified copies of the test reports covering each shipment shall be submitted to the Engineer.

Each length of pipe and each fitting shall have the following data clearly marked on each piece:

1. Nominal size
2. Type and grade of material and ASTM standard
3. SDR, Class, or schedule rating
4. Manufacturer
5. National Sanitation Foundation's seal of approval

1.07 QUALITY CONTROL

A. Inspection and testing shall be performed in accordance with the Township Water and Sewer Standard Specifications.

B. Prior to covering any portion of the Building Sewer, it must be inspected by the Authority.

1. Gravity laterals must be tested with either air or water to 4 PSI for 15 minutes in the presence of the Township inspector.
2. Pressure laterals must be tested with water to 50 PSI for 15 minutes in the presence of the Township inspector.

No work will be accepted unless it has been inspected and tested. All testing shall be per the pipe manufacturer's specifications.

1.08 NOTIFICATION OF TOWNSHIP

A. The Contractor must notify the Township at least 48 hours prior to beginning operation so that an Observer can be scheduled to be present. Under no condition are operations to commence without this notification and an Observer present.

1.09 STORAGE AND PROTECTION

A. PVC piping and accessories shall be stored and protected as follows:

1. PVC pipe and fittings shall be stored under cover.
2. All pipe and accessories shall be stored above ground and be fully supported so as not to bend or deflect excessively under its own weight. Height of stacked pipe shall not exceed 4 feet. Bundled pipe shall not be stacked more than two bundles high.
3. Kinked, flattened, buckled, broken, or otherwise defective pipe and fittings shall not be used and shall be removed from the site.
4. Pipe shall be handled using nylon slings. Wire rope slings or chains shall not be used.

B. Sewage grinder pumps shall be stored in accordance with the manufacturer's recommendations.

1.10 GUARANTEE

A. Provide a guarantee against defective equipment, materials, and workmanship in accordance with the requirements of the section entitled "Guarantees and Warranties" of these Specifications.

PART 2 PRODUCTS

2.01 PIPE MATERIALS

A. Ductile Iron Pipe (DIP)

1. Ductile iron sewer pipe and ductile iron pipe shall be centrifugally cast pipe with cement mortar lining and with bitumastic coating inside and outside. Joints shall conform with ANSI Specification A-21.11 Class 52. Pipes shall be laid in accordance with the Manufacturer’s recommendations.

B. Polyvinyl Chloride

1. Gravity Laterals

a. Gravity pipe (20’ maximum length) shall meet SDR-35 requirements of ASTM Specification D-3034-74. Pipe shall have integral wall, bell, and spigot joints with elastomeric gasket. Maximum allowable deflection after installation shall be 5%. Installation shall be in accordance with ASTM D-2321, “Underground Installation of Flexible Thermoplastic Sewer Pipe”, and as specified herein.

b. All fittings and accessories shall be SDR-35 and shall be manufactured by the pipe supplier.

2. Pressure Laterals

a. The pipe shall meet the requirements of ASTM D1785, Schedule 40 or SDR 21 as follows:

1. Schedule 40 PVC pipe shall be solvent cemented and the cement shall conform to ASTM D2564.

2. SDR-21 pipe shall have integral wall, bell, and spigot joints with elastomeric gasket.

3. Maximum allowable deflection after installation shall be 5%. Installation shall be in accordance with ASTM D-2321, “Underground Installation of Flexible Thermoplastic Sewer Pipe”, and as specified herein.

b. Pipe, fittings, etc. shall meet the requirements of ASTM D2467, Type 1, Grade 1.

2.02 PIPE ACCESSORIES

A. *Fittings:* Same material as pipe, molded or formed to suit pipe size and end design, in required 'T', bends, elbows, clean-outs, reducers, traps, and other configurations required.

B. *Pipe Saddles:* Pipe saddles are only to be used when connecting into an existing line where a wye has not been installed. These wyes shall be Sealtite Type "E" Multi-Range Wye Sewer Saddle manufactured by The General Engineering Company (GENECO) or approved equal.

2.03 SEWAGE GRINDER PUMPING SYSTEMS

A. Station Configuration

1. Basins shall be supplied in a wet well configuration. Wet well must have minimum storage volumes above alarm level according to the following:

Overall Station Height	Minimum Reserve Storage Above Alarm Level
84” (2.1 Meters)	106.2 gallons (402 Liters)

B. Factory Wiring

1. All wiring in the grinder pump station shall be installed and functionally tested prior to shipment from the factory. No field wiring other than connections to the control panel will be acceptable. All wire connections inside the basin wet well must be completed during factory assembly and 100% functionally tested prior to shipment. This includes all control panel connections. All electrical wires penetrating or passing through the silhouette of the pump station must be guaranteed to be water tight by the manufacturer and must be installed at the factory prior to shipment. No junctions. Plugs, electrical quick disconnects (EQD’s) etc. will be allowed between the pump motor housing and the junction box. Nor junction box and control panel. Direct burial electrical cable must be factory installed in the station and arrive at the job site with a minimum length of fifty (50) feet external to the station ready to unroll and connect to power source and control panel. Factory wiring and testing shall be a specific part of the UL listing.

C. Check Valve

1. The stainless-steel pump discharge piping shall be equipped with factory installed gravity operated flapper-type check valve. Gravity operated ball type check valve shall not be permitted. This valve will provide a full ported passageway when open, and shall not be permitted. This valve will provide a full ported passageway when open and shall introduce a friction loss of less than six inches of water at maximum rated flow. Working parts will be made of 300 series stainless steel and non-wicking fabric reinforced by neoprene flap to

ensure corrosion resistance, repeatability and dimensional stability. The valve body shall be powder-coated cast iron for corrosion resistance.

D. Redundant Check Valve

1. Each basin package shall include one (1) schedule 40 PVC type II swing check valve for installation by others in the service lateral between the grinder pump station and the low-pressure sewer main. Valves shall be 1.25 inch NPT and only require ½ pound of back pressure for complete closure.

E. Level Detection

1. Level detection for controlling pump and alarm operation shall be accomplished by use of a detection mechanism specifically designed for use in a sewage grinder pump basin and shall be removable without the need to remove the pump. Switches utilized in the system shall be hermetically sealed in a submersible, watertight protective casing. Level detection mechanism shall be a Barnes "FloatTree™" type designed to provide switch protection from solids, greases, oils and fats. Level detection mechanism shall not require any regular, preventative maintenance. The level detection mechanism shall consist of three switches, one for each function (HIGH WATER ALARM, ON and OFF functions). Switch assembly shall utilize an 18-5 cable, color coded leads. Switch assembly shall be 100% tested prior to shipment. The control assembly shall be part of the U.L. 1951 listing. The level controls shall be serviceable without the need for a confined space entry as defined by OSHA or the need to remove the pump. Conventional suspending of mercury floats, mechanical, or swing arm floats for HIGH WATER ALARM, ON and OFF functions will not be acceptable.

F. Shut-Off Valve

1. The pump discharge shall be equipped with a factory installed, true union, manual ball valve. Ball valves shall be full ported, constructed of PVC, with a minimum rated pressure of 150 PSI. All valves shall be operable from ground level. Shut off valve must be replaceable without excavating basin exterior. Duplex station shall utilize two shut off valves, each equal to the size of the pump discharge.

G. Anti-Siphon Function

1. The pump shall be constructed for a positively primed, flooded suction. As added assurance that the pump cannot lose prime, even under negative head conditions in the discharge piping, the pump must include a provision for a flapper style valve in the discharge line prior to the check valve. The design shall provide for a maximum bypass, under normal operating conditions, of no more than 1 GPM.

H. Basin Construction and Assembly

1. The basin shall be fiberglass reinforced polyester resin with a 3" ballast support flange. Dimensions shall be 24" diameter by 84" depth. The basin shall be furnished with one flexible inlet flange (shipped loose to facilitate field location) to accept a 4" SDR 35 PVC pipe. Inlet location can vary to accommodate ease of installation. (See installation instructions or consult factory for details). Basin capacities and dimensions shall be as shown on the contract drawings or as specified herein. The basin FRP wall laminate thickness shall vary with the wet well depth to provide the aggregate strength to meet the tensile and flexural physical property requirements. The basin FRP wall laminate must be designed to withstand wall collapse or buckling based on a hydrostatic pressure of 62.4 pounds per square foot, a saturated soil weight of 120 pounds per cubic foot, a soil modulus of 700 pounds per square foot. Basin must comply with the pipe stiffness values as specified in ASTM D 3753. The basin laminate must be constructed to withstand or exceed 150% of the assumed loading on any depth. The finished FRP laminate will have a Barcol hardness of at least 90% of the resin manufacturer's specified hardness for the fully cured resin. The Barcol Hardness shall be the same for both interior and exterior surfaces. Manufacture must submit documentation including calculation and production certification that basin (s) on the project are in compliance with the above requirements.

2. All piping inside the basin silhouette shall be at a level in the station that is lower than the frost depth or depth of bury specified for the low pressure sewer piping, whichever is lowest. The basin package shall be furnished with the factory pre-wired junction box. IN case of groundwater flooding around grinder station location, the junction box shall be protected from such ground water.

3. Cover shall be a molded polyethylene, grass green color. Junction box shall be NEMA 6 rated and mounted on the underside of the cover. The junction box and cover assembly shall be capable of providing adequate means of venting the basin.

4. Basin shall be UL Listed to Standard 1951.

5. All discharge pipe shall be constructed of 300 Series Stainless Steel and terminate outside the bulkhead with a stainless steel, female NPT fitting. The manufacturer shall guarantee all bulkhead penetrations watertight. Each system Shall be equipped with a 1.25" Male S.S. NPT x 1.50" female S.S. NPT, 12" length stainless steel flexible discharge coupling to accommodate misalignment to the discharge pipe and to absorb backfill shear forces. The inner corrugated hose and outer braid shall be constructed of 300 series stainless steel and shall have a maximum working pressure of 250 PSI.

I. Pump & Level Control Removal System

1. Each basin shall be equipped with a 300 series stainless steel "C" channel rail assembly to facilitate removal of the pump(s) and level control(s) from ground level. A ½" diameter knotted polypropylene rope with a breaking strength of 3.780 lbs. shall be supplied for pump and level control removal. Removal system must not require the loosening of fasteners to facilitate removal of pump or level control and shall provide for automatic alignment and re-connection of discharge piping for the replacement pump and correct height location for level control. Pump and level control replacement shall not be accomplished while the basin is full of sewage without the need to de-water the basin.

2.03 PUMPS

A. Design

1. A centrifugal submersible grinder pump designed to reduce all material found in normal domestic sewage, including plastic, rubber, sanitary napkins, and disposable diapers into a finely ground slurry. The resultant slurry is then pumped through small diameter piping, gravity interceptor, or treatment facility. The temperature limitation of the liquid being pumps is 160 °F (71 °C) intermittent and shall be capable of running dry for extended periods of time. Pump(s) shall be suitable for long term submergence in sewage. Grinder pump(s) shall be U.L. Listed to Standard 778 and CSA Listed to Standard 108.

B. Performance

1. In order to ensure proper operation in all conditions, pump(s) must provide, without overheating in a continuous operation, maximum head condition required by the system. Pump(s) must also be capable of operating at zero or negative heads without damage to the pump(s). Operating conditions shall be as follows:

Flow	8 GPM
Total Dynamic Head	50 feet
Shut off Head	55 feet

C. Construction

1. The volute seal plates and motor housing shall be constructed of high quality ASTMA-48 class 30 cast iron. The pump(s) shall be painted with air dry of 2 mil minimum thickness. All exposed hardware shall be 300 series stainless steel. Discharge connection shall be a standard 1.25 inch NPT in the vertical position using a threaded bolt on discharge flange.

2. The pump impeller shall be of the recessed, vortex design. Pumps with standard centrifugal semi-open impeller designs shall not be acceptable. The impeller shall be of 85-5-5-5 bronze construction and machined for threading to the

motor shaft. The impeller shall be capable of being trimmed to meet specific performance characteristics.

3. The pump shall be a three bearing design consisting of an upper ball bearing, an intermediate ball bearing restrained for the purpose of carrying the thrust loads and an oil lubricated lower bronze sleeve bearing to carry radial loads and prevent shaft deflection imposed by the pump impeller and grinder operation. The oil lubricated sleeve bearing shall be located between two mechanical seals. Lip type seals are not acceptable. Designs reducing the number of bearings or substituting sleeve bearings for ball bearings will not be considered equal.

D. Grinder

1. The grinder mechanism shall be specifically designed for use in a grinder pump. Garbage disposal cutting mechanisms are not acceptable. The mechanism shall consist of a radial cutter threaded and locked on the motor shaft by a washer in conjunction with a counter sunk flat head cap screw, and a matching shredding ring. Grinding shall be accomplished by a slicing action as opposed to a chopping action. Chopping-type cutter mechanisms will not be allowed. Grinder design shall be able to alternately engage cutters at start and shall exert a minimum cutting force of 30 pounds, thus eliminating the need for excessive motors. The shredding ring shall be reversible to provide twice the cutting life. All grinding mechanism components, including both the shredding ring and radial cutter and its impeller (if required), shall be constructed of 440C stainless steel hardened to a minimum Rockwell C55 and shall be finish ground for a fine cutting edge. Two stage cutter mechanisms and/or those requiring external adjustment for proper clearance shall not be acceptable.

2. The grinder shall be placed immediately below the pumping elements and shall be direct-driven by a single, one-piece, stainless steel motor shaft. The grinding assembly operates without objectionable noise or vibration over the entire range of recommended operating pressures. The grinder shall be constructed so as to eliminate clogging and jamming under all normal operating conditions including starting. In order to demonstrate adequate flow velocity and grinding capability, the grinder pump shall be capable of passing series of stringy type solids (diapers, rags, feminine products, etc.) through the pump without roping or winding the material in or immediately below the pump suction.

3. 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, rubber and the like, to finely-divided particles which will pass freely through the passages of the pump and the discharge piping. The grinding mechanism must be capable of handling reasonable amounts of grit, often found in domestic sewage systems.

E. Electric Motor

1. Single phase motors of the capacitor start, capacitor run, NEMA L design and three phase motors shall be of the dual-voltage 240/480, NEMA B design. The motor shall be designed to be non-overloading throughout the entire pump curve. The motor shall be constructed with the open windings operating in a sealed housing, which contains clean dielectric oil for heat dissipation from the windings and for lubrication of the bearings, making it capable of operating in a totally, partially, or non-submerged condition for extended periods of time without damage due to heat being generated. Oil used must be able to be disposed of as non-hazardous waste. Air filled motors shall not be acceptable. The rotor and stator assembly shall be of the standard frame design and secured to the pump seal plate by four threaded fasteners allowing for easy serviceability. Motor designs incorporating shrink or press fit assemblies between the stator and motor housing shall not be considered acceptable. The motor shaft shall be of 416 stainless steel.

2. Protection against excessive temperature shall be provided by heat sensor thermostat attached to the stator windings and connected in series with the contractor coil in the control panel for all models except the 200 and 240 volt, single phase SGV*2022L and SGV*2002L. The 200 and 240 volt, single phase models shall provide protection against excessive temperature through the use of an in-line heat/current sensor. The sensor shall be connected in series with, and attached to the motor windings. 240 volt, single phase pumps requiring a sensor to be wired in series with the contactor coil shall not be acceptable.

3. The pumps shall be equipped with type SOW power cable. The power cable is connected to the motor via quick disconnect pin terminals. Threaded cord grip type cord entries are not acceptable. Pin receptacles shall be crimped and molded to the power cord in a PVC plug. The plug shall be secured with a stainless-steel compression plate to prevent water from entering the motor housing and to provide strain relief at the point of cable entry. A stainless steel clamp shall compress the PVC molding against the cable jacket to prevent water from entering the jacket. A polybutylene terephthalate terminal block with brass pin inserts shall connect the power cord leads with motor leads. The ground pin shall be longer than the other pins such that the ground connection is the first connection made and the last connection broken when the plug is inserted and removed, respectively. A Buna-N o-ring shall provide isolation sealing between terminal block and the motor housing. The plug assembly shall be guaranteed by the manufacturer to meet UL approval for submersion.

F. Mechanical Seal

1. The pump shall utilize a tandem mechanical shaft seal arrangement and shall operate in an oil atmosphere. Each seal shall be double floating, self aligning rotary shaft seals to prevent leakage between the motor and pump. The materials of construction shall be carbon for the rotating face and ceramic for

the stationary face, lapped and polished to a tolerance of one light band, with 300 stainless steel hardware, with all elastomer parts of Buna-N. The seal shall be commercially available and not a proprietary design of the manufacturer.

G. Testing

1. Each grinder pump shall be submerged, operated and tested for performance compliance to its respective curve. Testing process and periodic inspection of testing process shall be conducted and approved by U.L.

2.04 CONTROL PANEL

A. General

1. A wall mounted control panel shall be supplied with each station. All control panels shall be UL Listed to meet Standard 508. Each panel shall be constructed with padlockable NEMA 4X fiberglass enclosure and utilize stainless steel hardware.

B. Simplex Control Panels

1. The control panel shall include as a minimum: circuit breakers, fuses, terminal strip, ground lug, capacitors when required, IEC rated motor starters, relays, alarm light, internal push to run button. The control panel shall include an elapsed time meter for each pump, controlled by the panel, to indicate pump run time in hours and tenths of hours to a minimum of 9999.9 hours.

C. High Water Alarm Devices

1. Each control panel shall include a visual and audible, with silence, high water alarm device. Alarm circuit shall be separately fused from motor control circuit. The visual alarm shall be a red fluted lens mounted to the top of the enclosure in such a manner as to maintain rain-proof integrity. The 90db audible device shall be capable of being de-activated by means of a NEMA 4X silence button mounted on the exterior of the enclosure. Visual alarm will remain on as long as high water condition exists in the basin. Both visual and audio alarms will automatically reset when the high-water condition subsides.

2.05 MANFUCTURE

A. The simplex grinder pump station shall be manufactured by Barnes or approved equal.

PART 3 EXECUTION

3.01 GENERAL

A. All pipes shall be unloaded, handled and stored in conformance with the manufacturer's recommendations.

B. Pipes shall be laid at a grade not less than 1/4 inch per foot (2.08%) unless a lesser grade is approved by the Township. Each section of pipe shall rest upon the pipe bed for the

full length of its barrel, with recesses excavated to accommodate bells and joints. Any pipe, which has its grade or joints, disturbed after lying shall be taken up and relaid. Pipe sections shall be inspected, and the interior and ends of all pipe shall be cleaned before lowered into the trench. During construction, the Contractor shall use all precautions to keep the pipe clean and clear of debris and free from damage until finally inspected and accepted. The mouth of the completed sewer pipe shall be properly closed at all times with an expanded rubber plug or other approved device, except when pipe lying is in progress.

C. Pipe laying shall be done only in the presence of an Observer. The Contractor shall notify the Township at least 48 hours prior to beginning pipe laying.

D. When necessary to cut pipe to size, it shall be done by saw cutting, neatly and cleanly.

E. Bedding and lying of pipe shall be in accordance with the pipe manufacturer's recommendations. Pipe joints shall be made in accordance with the joint manufacturer's recommendations.

F. Regardless of its material, all pipes shall be laid on a minimum six-inch (6") thickness of AASHTO No. 67 stone as approved by the Township.

G. If the house sewer is not to be connected immediately to the lateral, the lateral pipe stub shall be capped with a watertight pressure type fitting capable of withstanding the exfiltration tests and is to remain until future connection to the house sewer. The ends of all laterals not immediately connected to the house sewer shall be physically marked to show location and depth of pipe end. Method of marking to be a 1" x 3" board extending from the end of the lateral to a height of 12" above grade. Depth of lateral is to be marked with a felt-tipped marking pen on that portion extending above grade.

H. Laterals shall be of the same type of material as the sewer line to which the lateral connects unless otherwise approved by the Township.

I. Laterals shall not be installed directly from a manhole unless written approval is received from the Township.

3.02 EXCAVATION

A. Existing road surfaces are to be neatly cut along edges of the proposed trench prior to excavation.

B. Extreme care is required when excavating to expose the existing sewer main. To prevent damage to the main sewer line, machine excavation shall be terminated and hand excavation begun within a radius of two feet of the main sewer line.

C. Trenches shall be dug to depths and widths as specified herein or as approved by the Engineer. Sides of trenches shall be nearly vertical as possible.

D. Trenches shall be excavated true to line so that a clear space of eight (8) inches, no more, is provided on each side of the pipe bell to a height not less than the top of the

pipe. These dimensions are applicable to the inside face of sheeting, if such is required at the elevation of the pipe. Trenches may be wider above the top of pipe.

E. When the width below top exceeds bell plus 16 inches, Township may call for stronger pipe at no expense to Township.

F. Where a section of trench has, by the Contractors own mistake, been excavated to a greater depth than specified, it shall be brought to the proper grade using AASHTO No. 67 crushed stoned.

3.03 TRENCH DEWATERING

A. Maintain excavations free of water. Water removed from excavations shall be disposed of in such a manner as to prevent damage to public or private property, or to any portion of the work completed or in progress. In no case shall water be permitted to rise into or flow through a completed sewer unless written permission is obtained by the Township.

3.04 PIPE INSTALLATION

A. All laying, jointing, testing for defects and for leakage shall be performed in the presence of the Township. All defects in workmanship rejected by the Township shall be promptly corrected by the Contractor and defective material removed from the Project.

B. The excavation in which pipe is being laid shall be kept free from water, and no joint shall be made under water. Care shall be used to secure water-tightness and to prevent damage to, or the disturbing of, the joints during the backfilling process or at any other time. After pipes have been laid and the joints have been made, there shall be no walking on or working over them except as may be necessary in tamping until there is a covering at least two (2) feet in depth over their top. After joint materials, which require it, have received their set, backfilling of the trench may proceed in the manner specified.

C. Before joints are made, each pipe shall be well bedded on a solid foundation and no pipe shall be brought into position until the preceding length has been thoroughly embedded and secured in place. No pipe shall be laid in wet trench conditions that preclude proper bedding, or on a frozen trench bottom, or when in the opinion of the Township, the trench or weather conditions are unsuitable for proper installation. Any defects due to settlement shall be corrected by the Contractor at his own expense. Bell holes or coupling holes shall be dug sufficiently large to insure making of proper joints. In no case will pipe be closer than four (4) inches from bedrock.

D. In laying pipe, special care shall be taken to insure that each length shall abut against the next in such a manner that there shall be no shoulder or unevenness of any kind along the inside of the pipe line.

E. No wedging or blocking will be permitted in laying pipe unless by written order from the Township.

F. Pipes and fittings shall be thoroughly cleaned before they are laid and shall be kept clean until the acceptance of the completed Work. The open end shall be kept closed with a stopper until the next length is laid. At the close of work each day, the end of the pipe line shall be tightly closed with an expansion stopper so that no dirt or other foreign substances may enter the line, and this stopper shall be kept in place until pipe laying is again resumed.

G. Cold weather protection shall be provided, during freezing weather, for all masonry, mortar and concrete construction connected with the exterior piping by maintaining a temperature of not less than 50°F for a period of three (3) days, or by backfilling immediately, or by covering with backfill material in a temporary manner, all as directed by the Township.

H. All open ends of pipelines to be abandoned, exposed during construction operations shall have their openings plugged with a two-(2) foot minimum thickness of concrete.

I. All dead-ends of pipelines, and fittings, shall be provided with standard plugs and caps either temporarily or permanently as directed by the Township. A concrete or other approved thrust blocking shall be provided at all dead ends. Where plugged or capped outlets are to be tied to fittings with clamps and tie rods, as indicated on the Contract Documents or as directed by the Engineer, the minimum number and size of rods and other pertinent details shall be as shown and/or specified.

J. Anchorage, buttresses, and thrust blocks shall be used to secure all caps, plugs, horizontal and vertical bends, branches, tees, and dead ends. They shall be constructed in accordance with the Standard Details, unless otherwise specified, and shall bear against solid, undisturbed earth.

3.05 INSTALLATION OF A SADDLE WYE FITTING

A. Regardless of the combination of materials used installing a lateral to sewer main (PVC, or DIP), saddle Wye fitting shall be manufactured by The General Engineering Company (GENECO), Frederick, Maryland.

B. On PVC pipe, installation shall be according to the following guidelines:

1. Place saddle in position on pipe for use as a template and mark guide for hole cut-in. Remove saddle from pipe. If a separate template is supplied with the saddle Wye, use it for a guide.

2. Using hole guide mark cut hole through pipe wall outside the hole guide mark by the thickness of the saddle stem. The diameter of the hole should not exceed the outside diameter of the saddle stem by more than 1/4". Use a hand keyhole saw or power saber saw to cut the hole. For most saber saws with heavy-duty blades, the blade should be held horizontally across the pipe and pressed downward until it penetrates the pipe wall. The blade can then be brought to the vertical position and the hole cut completed. Cut or bevel the downstream end of the hole at a 45 angle to allow the saddle stem to fit.

3. Wipe clean and dry both the underside of the saddle and the mating surfaces of the pipe.

4. Position saddle over the hole. Place the stainless steel strap around the pipe and connect with nuts and bolts provided by manufacturer.

5. Tighten strap until the recommended torque has been reached by hand. The minimum torque applied should be 5 ft. - lbs.

6. H.E.S. concrete shall then be manually placed around the saddle and sewer main, then rodded and brought back up to the spring line to provide continuous support for both.

Note: If saddles are not properly positioned, the rubber gasket may not be touching the pipe, possibly resulting in a leak.

3.06 BACKFILL

A. Ductile Iron Pipe

1. The procedure for backfilling ductile iron sewer pipe shall be as follows: After the sewers have been installed, the material directly around the pipe shall be hand tamped. Then, in such manner as not to disturb the pipe, backfill to a height of twelve (12) inches above the top of the pipe, and compact with a mechanical tamper. The remainder of the trench shall be backfilled by one of the following methods:

   a. When the pipeline is located within a State Highway, Township road, parking lot or other roadway area, the trench shall be backfilled in layers not exceeding six (6) inches in thickness and mechanically tamped.

   b. When the pipeline is located beneath an unpaved area, or area not subject to vehicular traffic, backfilling may be accomplished by filling to the ground surface in one operation and compacting by trench roller or special heavy-duty tamping machine. The backfill material may be deposited in the trench by the excavating equipment or a front-end loader from the end of the trench. Excavated material free of large stones, (stones greater than three (3) inches in any direction) may be used for this backfill.

   c. When the sewer is located within an existing Pennsylvania State Highway, Township Street or road, parking lot or other roadway area, the trench shall be backfilled with compacted 2RC stone.

2. Backfilling material, placed within two (2) feet of manholes and other structures, shall be deposited uniformly around the sides in layers not exceeding eight (8) inches in depth, and solidly tamped in such a manner as to avoid impairing the structures or producing unequal pressure on them.

B. PVC Pipe

1. The procedure for backfilling PVC sewer pipe shall be as follows: After the sewers have been installed on a firm bedding as shown on the standard detail, haunching material shall be carefully placed and consolidated under the pipe haunch to provide adequate side support. The haunching material shall be placed in four (4) inch compacted layers to the top of the pipe. The material shall be placed in such a manner as not to disturb the pipe. The haunch material shall be AASHTO No. 57 stone.

2. An eight-(8) inch layer of AASHTO No. 57 or 2RC stone backfill shall be placed above the spring line of the pipe to provide a protective cushion.

3. The remainder of the trench shall be backfilled by one of the following methods:

   a. When the pipeline is located within a State Highway, Township road, parking lot or other roadway area, the trench shall be backfilled in layers of 2RC stone not exceeding six (6) inches in thickness and mechanically tamped.

   b. When the pipeline is located beneath an unpaved area, or area not subject to vehicular traffic, backfilling may be accomplished by filling to the ground surface in one operation and compacting by trench roller or special heavy-duty tamping machine. The backfill material may be deposited in the trench by the excavating equipment or a front-end loader from the end of the trench. Excavated material free of large stones (stones greater than three (3) inches in any direction) may be used for this backfill.

   c. When the sewer is located within an existing Pennsylvania State Highway, Township Street or road, parking lot or other roadway area, the trench shall be backfilled with compacted 2RC stone.

4. Backfilling material, placed within two (2) feet of manholes and other structures, shall be deposited uniformly around the sides in layers not exceeding eight (8) inches in depth, and solidly tamped in such a manner as to avoid impairing the structures or producing unequal pressures on them.

3.07 INSTALLATION AND TESTING OF SEWAGE GRINDER PUMPING SYSTEMS

A. Install units and associated piping and valving in strict accordance with manufacturer's instruction and installation manual, and in locations and in accordance with the submitted Plan Sheet. Install units on a six-inch deep compacted layer of aggregate meeting all requirements. Install pipe zone bedding material as backfill up to highest pipe connection. Form and pour anti-flotation concrete anchors in accordance with all requirements. Use Class B (3,000 psi) concrete.

B. The manufacturer shall also provide a copy of an operation and maintenance manual covering general operating procedures, operation, maintenance, and servicing procedures of the major individual components, and a trouble-shooting guide.

C. The Contractor shall provide the services of a technical representative of the equipment manufacturer to supervise the final adjustments of the system, perform such operating tests as will assure the Township that the equipment is in proper adjustment and satisfactory operating condition, and to instruct and train the Homeowner's in the use of the equipment. This service shall be rendered after installation of the equipment has been completed and the entire system is ready for operation.

D. The complete sewage grinder pumping system shall be in good working order before it is turned over to the Homeowner for acceptance and operation.

3.08 INSTALLATION AND TESTING OF ELECTRICAL SERVICE

A. No existing electrical service shall be interrupted without the permission of the Homeowner.

B. Provide two-foot minimum cover over underground electrical cables. Make electrical cable penetrations through the tank absolutely watertight. Perform grounding of electrical system and metal enclosures in accordance with Article 250 of the NEC. In addition use approved grounding connectors only. Clean the surfaces involved in the made-grounds before connecting and finish the installation with touch-up painting or other protective coating to prevent corrosion.

C. All equipment shall be mounted using approved bolts, anchors, and fasteners. Adhesives shall not be used to mount electrical devices.

D. Panel boards, if required, installed against concrete or basement walls, which may become damp, shall be separated from the wall by 1/4-inch spacers.

E. Installation shall be in conformance with the manufacturer's recommendations and instructions and in conformance with all local codes.

F. After installation, circuit breakers shall be checked for proper operation and all connections checked for tightness and security.

G. All cables and leads shall be tested for continuity and power.

H. During construction, all installed conduits shall be temporarily plugged, capped, or otherwise protected from the entrance of dust, trash, moisture, etc., and to prevent any conduits from becoming clogged. No conductor shall be pulled in until all work that might cause damage to the conduit or conductors has been completed.

I. Conduit straps or brackets secured to concrete, brick, or masonry shall be by means of expansion bolts, toggle bolts, or approved drill anchors. No wood plugs will be permitted.

J. Field bending of polyvinyl chloride conduit shall be made with appropriate equipment. No torches or flame-type devices shall be used.

K. When joints are to be made with polyvinyl chloride conduit, the conduit shall be cut with a fine-tooth saw and deburred. Conduit ends shall be wiped clean of dust, dirt, and shavings and shall be dry. Solvent cement shall be applied to bond the joint. The joint shall be watertight.

L. Conduit shall be installed in accordance with the manufacturer's specifications and recommendations and shall conform to all local codes.

M. After installation, conductors shall not have dents, scars, cuts, pressure indentations, abraded areas, etc.

N. Contractor is responsible for installation of electrical service from grinder pump to an electrical control panel, also installed by Contractor. Contractor also is responsible for providing power to the control panel from property owner's existing circuit breaker panel.

O. Electrical systems tests must be completed in the presence of the Township. Electrical work must be inspected by authorized inspection agency for compliance with the NEC. The entire installation must be rendered free from short circuit and improper grounds. In no case shall the insulation resistance be less than one hundred thousand ohms. Perform initial electrical system tests using meggers, ammeters, voltmeters, insulation resistance testers, and high-pot testers prior to placing electrical systems into complete operation. Use meggers with an adjustable 2.5/5.0 KV range which will permit reading of 0.05 to 100,000 Megohms. The minimum testing voltage obtained by adding 1000 V to twice the rated voltage of the cable, device, apparatus or equipment in no case should the resistance be less than one Megohm. However, the recommended insulation resistance measurement of each test shall conform to the IEEE and ANSI Standards.

1. Connect 120V temporary power source to the alarm circuit at the control panel and fill the tank with sufficient water to test the high level audible and visual alarms

2. Run the unit through a minimum of three operation cycles to check pump operation and shut-off.

3. Contractor shall repair all deficiencies

3.09 EXISTING SEPTIC SYSTEM ABANDONMENT

A. All existing septic tanks, grease traps, cisterns, manholes or any other on-site treatment system component shall be abandoned after connection to the sewage system. All underground tanks including septic, pump, cisterns, seepage pits and cesspools shall have all liquid and sludge removed from them. After these tanks have been cleaned they shall be filled with soil, stone or other suitable material. The drain field piping does not have to be removed or filled unless the property owner wishes to do so. The

Contractor shall notify Bucks County Health Department of decommissioning of the on-lot system.

END OF SECTION

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SECTION 02810

MONITORING WELL

PART 1 GENERAL

1.01 WORK INCLUDED

A. The Contractor shall furnish all labor, material and equipment required for installation of monitoring wells indicated on the Drawings and specified herein.

1.02 REFERENCES

A. ANSI/AWWA A100 - Standard for Water Wells.

1.03 SUBMITTALS

A. Submit under the provisions of the Section 01300.

B. Submit Well Driller's Certifications.

C. Upon completion of the well, the Contractor shall submit the following information:

1. Drill cuttings and records, which show all pronounced changes in information.
2. Well logs.
3. A complete casing location record showing lengths of each diameter of casing.
4. All test data, including static water level, length of test.
5. Plumbness and Alignment test records.
6. Water quality analysis.

1.04 QUALITY ASSURANCE

A. Perform work in accordance with Section 01400.

B. Laboratory Services: Provide water quality analysis for all parameters regulated by current Pennsylvania Department of Environmental Protection groundwater requirements. Analyses shall be performed by a certified laboratory.

C. All monitoring well construction, inspection and testing shall be performed under the supervision and review of a Professional Geologist licensed in the Commonwealth of Pennsylvania.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle equipment according to manufacturer's instructions and the provisions of Section 01600.

1.06 SCHEDULING AND COORDINATION

A. Schedule work under the provisions of Section 01300.

B. Coordinate the delivery and installation of the work of this section with the work of other sections.

1.07 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 01700.

B. Record actual locations of pipes, utilities, equipment and accessories.

PART 2 PRODUCTS

2.01 GENERAL

A. All materials and construction, developing and testing procedures necessary for completion of the well installations shall be in accordance with the latest provisions of the American Water Works Associations Standard Specifications for Deep Well, AWWA A100.

B. The Contractor shall obtain all necessary permits to fulfill the applicable requirements of PADEP.

C. The Contractor of the groundwater monitoring system shall be responsible for the proper construction of the system per the design documents and approved plans. All groundwater wells shall perform as specified and the completed installation shall operate in accordance with the requirements in this specification.

2.02 WELL

A. The bore hole will penetrate the aquifer surface twenty to thirty feet.

B. The wells shall have a 6-inch well casing and be so constructed as to produce a water supply free from sand.

C. The wells shall be constructed as shown on the contract drawings.

D. The Contractor shall perform all necessary testing in accordance with the requirements of Pennsylvania Department of Environmental Protection groundwater requirements.

PART 3 EXECUTION

3.01 INSTALLATION

A. Installation shall conform to recommendations provided by the Professional Geologist and as described by the Specifications and Drawings.

3.02 INITIAL BACKROUND TESTING

A. After the installation is complete, a Professional Geologist shall submit PADEP Module 5A-Phase II (Ground Water Quality Monitoring Information)

END OF SECTION

SECTION 02826

AGRICULTURAL FENCE

PART 1 GENERAL

1.01 DESCRIPTION

A. The work of this section consists of furnishing and installing high tension wire fencing.

1.02 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Shop Drawings: Indicate detailed dimensions, post with concrete foundation details, brace and anchor requirements.

C. Product Data: Provide product data on rails, posts and accessories.

D. Manufacturer's Installation Instructions: Indicate installation requirements and special procedures.

1.03 QUALITY ASSURANCE

A. Perform Work in accordance with Section 01400.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle equipment according to manufacturer's instructions and the provisions of Section 01600.

1.05 SCHEDULING AND COORDINATION

A. Schedule work under the provisions of Section 01300.

B. Coordinate the delivery and installation of the work of this Section with the work of other Sections.

1.06 WARRANTY

A. The manufacturer shall provide a warranty against any defect or malfunction due to workmanship in the equipment and accessories for a period of one (1) year from date the system is put into service.

B. A written manufacturer's warranty shall be supplied.

PART 2 PRODUCTS

2.01 WOOD POSTS

A. Material of construction - Southern Yellow Pine, round , without bark, minimum 84" long, 5-6 inch in diameter. The wood shall be pressure treated to the AWPA C16 standard at 0.40 PCF of copper azole (CA) for ground contact.

B. Spacing every 15'

2.02 WOOD BRACING

A. Material of construction - Southern Yellow Pine, round , without bark, minimum 96" long, 5-6 inch in diameter. The wood shall be pressure treated to the AWPA C16 standard at 0.40 PCF of copper azole (CA) for ground contact.

B. Required at every end and corner.

2.03 HIGH TENSILE WIRE

A. High Tensile Wire shall meet or exceed the following criteria:

1. Wire: 12 ½ gage, class 3 wire, with a minimum tensile strength of 170,000 pounds per square inch (psi), galvanized steel wire.

2. Wire tension for high tensile fences shall be minimum 150-300 lb. tension per wire.

3. Have a minimum of Class III galvanization (80 ounces of zinc per square inch of wire surface).

2.05 ACCESSORIES

A. Commercial splices recommended by the wire manufacturer shall be used on high tensile fences.

B. Brace pins: 3/8" diameter galvanized steel pins.

C. Staples: 8 or 9 gauge Class 3 galvanized barbed-type staples.

2.06 CONCRETE

A. ASTM C 94, using ¾-inch maximum size aggregate, and having minimum compressive strength of 3000 psi at 28-days. Grout shall consist of one part Portland cement to three parts clean, well-graded sand and the minimum amount of water to produce a workable mix.

PART 3 EXECUTION

3.01 INSTALLATION

A. Fence shall be installed to the uniform lines and grades indicated. The area on either side of the fence line shall be cleared to the extent indicated. Line posts shall be spaced equidistant at intervals not exceeding 15-feet.

3.02 EXCAVATION

A. Postholes shall be cleared of loose material. Waste material shall be spread where directed.

3.03 POST INSTALLATION

A. Posts shall be set plumb and in alignment. Except where solid rock is encountered or for posts supporting gates, posts shall be set native soil to the depth indicated on the drawings. Where solid rock is encountered with no overburden, posts shall be set to a minimum depth of 18-inches in rock. Where solid rock is covered with an overburden of soil or loose rock, posts shall be set to the minimum depth indicated on the drawing unless a penetration of 18-inches in solid rock is achieved before reaching the indicated depth, in which case depth of penetration shall terminate. All portions of posts set in rock shall be grouted. Portions of posts not set in rock shall be set in concrete from the rock to ground level. Posts set in concrete shall be set in holes not less than the diameter shown on the drawings. Diameters of holes in solid rock shall be at least 1-inch greater than the largest cross section of the post. Concrete and grout shall be thoroughly consolidated around each post, shall be free of voids and finished to form a dome. Concrete and grout shall be allowed to cure for 72-hours prior to attachment of any item to the posts. Group II line posts may be mechanically driven, for temporary fence construction only, if rock is not encountered. Driven posts shall be set to a minimum depth of 3-feet and shall be protected with drive caps when being set.

B. Corner braces: All corner braces shall be a “Double H” type. Fence contractor shall submit design drawing on bracing before installation.

C. Sweep Corners: Sweep corners shall be constructed using posts leaning against the pull of the wire. For every 10-degree directional change use a 4” x 8’ post on a 4” lean, 4-feet deep. For every 20- degree change use a 5” x 9’ post on a 5” lean, 4 1/2 feet deep. For every 30-degree change use a 6” x 9’ post on a 6” lean, 5’ deep. String wire to the outside of the bend.

3.04 WIRE

A. Install wire in accordance with the USDA/NRCS guidelines for high tension fencing. Place the outside of the fence posts facing away from the spray fields.

3.07 CLEAN-UP

A. Remove resulting debris and leave area in a neat, clean acceptable condition.

END OF SECTION

SECTION 02831

CHAIN LINK FENCE

PART 1 GENERAL

1.01 WORK INCLUDED

A. The Contractor shall furnish and install a chain link fence as specified herein and as shown on the Drawings.

B. Chain link fence shall match the existing fence on the site.

1.02 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	Specification for Pipe, Steel Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 116	(1995) Zinc-Coated (Galvanized) Steel Woven Wire Fence Fabric
ASTM A 121	(1992 a) Zinc-Coated (Galvanized) Steel Barbed Wire
ASTM A 153/A 153M	(1998) Zinc-Coated (Hot Dip) on Iron and Steel Hardware
ASTM A 176	(1997) Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip
ASTM A 392	(1996) Zinc-Coated Steel Chain-Link Fence Fabric
ASTM A 478	(1997) Chromium-Nickel Stainless and Heat-Resisting Steel Weaving and Knitting Wire
ASTM A 491	(1996) Aluminum-Coated Steel Chain-Link Fence Fabric
ASTM A 585	(1997) Aluminum-Coated Steel Barbed Wire
ASTM A 666	(1996b) Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Paste, and Flat Bar
ASTM A 702	(1989; R 1994) Steel Fence Posts and Assemblies, Hot Wrought

ASTM A 780	(1993a) Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings
ASTM A 824	(1995) Metallic-Coated Steel Marcelled Tension Wire for Use With Chain Link Fence
ASTM C 94	(1998) Ready-Mixed Concrete
ASTM D 4541	(1995) Pull-Off Strength of Coatings Using Portable Adhesion Testers
ASTM F 626	(1996) Fence Fittings
ASTM F 668	(1996) Poly (Vinyl Chloride)(PVC) – Coated Steel Chain-Link Fence Fabric
ASTM F 883	(1997) Padlocks
ASTM F 900	(1994) Industrial and Commercial Swing Gates
ASTM F 1043	(1998a) Strength and Protective Coatings on Metal Industrial Chain-Link Fence Framework
ASTM F 1083	(1997) Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures
ASTM F 1184	(1994) Industrial and Commercial Horizontal Slide Gates
ASTM G 23	(1996) Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials
ASTM G 26	(1996) Operating Light-Exposure Apparatus (Xenon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials
ASTM G 53	(1996) Operating Light and Water-Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Nonmetallic materials

1.03 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Shop Drawings: Indicate detailed dimensions, post with concrete foundation details, brace and anchor requirements.

C. Product Data: Provide product data on fabric, posts and accessories.

D. Manufacturer's Installation Instructions: Indicate installation requirements and special procedures.

E. Samples - Provide three samples indicating color choices for vinyl coating.

1.04 QUALITY ASSURANCE

A. Perform Work in accordance with Section 01400.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle equipment according to manufacturer's instructions and the provisions of Section 01600.

1.06 SCHEDULING AND COORDINATION

A. Schedule work under the provisions of Section 01300.

B. Coordinate the delivery and installation of the work of this Section with the work of other Sections.

1.07 WARRANTY

A. The manufacturer shall provide a warranty against any defect or malfunction due to workmanship in the equipment and accessories for a period of one year from date the system is put into service.

B. A written manufacturer's warranty shall be supplied.

PART 2 PRODUCTS

2.01 FENCE FABRIC

A. Fence fabric shall conform to the following:

1. Chain Link Fence Fabric

The chain link fence fabric shall be vinyl coated steel, #9 gauge, two-inch mesh. Color to be black.

2.02 GATES

A. Gates shall be installed in the sizes and at the locations as shown on the Drawings.

B. Swinging Gates: ASTM F 900 and/or ASTM F 1184. Gate frames shall conform to strength and coating requirements of ASTM F 1083 for Group IA, steel pipe, with external coating Type A, nominal pipe size (NPS) 1-1/2. Gate frames shall conform to strength and coating requirements of ASTM F 1043, for Group IC, steel pipe with external coating Type A or Type B, nominal pipe size (NPS) 1-1/2. Gate fabric shall be as specified for chain link fabric. Gate leaves more than 8 feet wide shall have either intermediate members and diagonal truss rods or shall have tubular members as necessary to provide rigid construction, free from sag or twist. Gate leaves less than 8 feet wide shall have truss rods or intermediate braces. Gate fabric shall be attached to the gate frame by method standard with the manufacturer except that welding will not be permitted. Latches, hinges, stops, keepers, rollers, and other hardware items shall be

furnished as required for the operation of the gate. Latches shall be arranged for padlocking so that the padlock will be accessible from both sides of the gate. Stops shall be provided for holding the gates in the open position. For high security applications, each end member of gate frames shall be extended sufficiently above the top member to carry three strands of barbed wire in horizontal alignment with barbed wire strands on the fence.

2.03 POSTS

A. Metal Posts for Chain Link Fence – Posts shall be black vinyl/powder coated framework. Sizes shall be as shown on the drawings. Line posts and terminal (corner, gate, and pull) posts selected shall be of the same designation throughout the fence. Gate post shall be for the gate type specified subject to the limitation specified in ASTM F 900 and/or ASTM F 1184.

2.04 BRACES AND RAILS

A. ASTM F 1083, zinc-coated, Group IA, steel pipe, size NPS 1-1/4. Group IC steel pipe, zinc-coated, shall meet the strength and coating requirements of ASTM F 1043. Group II, formed steel sections, size 1-21/32 inch, conforming to ASTM F 1043, may be used as braces and rails if Group II line posts are furnished.

2.05 WIRE

A. Tension Wire - Tension wire shall be Type I or Type II, Class 2 coating, in accordance with ASTM A 824.

B. Tie Wire - Tie wire for attaching fabric to rails, braces, and posts shall be 9 gauge steel wire and match the coating of the fence fabric. Miscellaneous hardware coatings shall conform to ASTM A 153/A 153M unless modified.

2.06 ACCESSORIES

A. ASTM F 626. Ferrous accessories shall be zinc or aluminum coated. Truss rods shall be furnished for each terminal post. Truss rods shall be provided with turnbuckles or other equivalent provisions for adjustment.

2.07 CONCRETE

A. ASTM C 94, using 3/4 inch maximum size aggregate, and having minimum compressive strength of 3000 psi at 28 days. Grout shall consist of one part Portland cement to three parts clean, well-graded sand and the minimum amount of water to produce a workable mix.

2.08 PADLOCKS

A. Padlocks shall conform to ASTM F 883, Type PO1; Option A, Size 1-3/4 inch. Provide total of three padlocks for the project. As manufactured by Master Lock

no exceptions. All padlocks shall be keyed alike with key number supplied by Township. The padlocks will be installed at all fence gates buildings and panel boxes as directed and monitoring wells on the site, if any.

PART 3 EXECUTION

3.01 INSTALLATION

A. Fence shall be installed to the lines and grades indicated in the construction plans. The area on either side of the fence line shall be cleared to the extent indicated. Line posts shall be spaced equidistant at intervals not exceeding 10 feet. Terminal (corner, gate, and pull) posts shall be set at abrupt changes in vertical and horizontal alignment. Fabric shall be continuous between terminal posts; however, runs between terminal posts shall not exceed 500 feet. Any damage to galvanized surfaces, including welding, shall be repaired with paint containing zinc dust in accordance with ASTM A 780.

3.02 EXCAVATION

A. Postholes shall be cleared of loose material. Waste material shall be spread where directed. The ground surface irregularities along the fence line shall be eliminated to the extent necessary to maintain a 1-inch clearance between the bottoms of the fabric and finish grade.

3.03 POST INSTALLATION

A. Posts for Chain Link Fence

1. Posts shall be set plumb and in alignment. Except where solid rock is encountered, posts shall be set in concrete to the depth indicated on the drawings. Where solid rock is encountered with no overburden, posts shall be set to a minimum depth of 18 inches in rock. Where solid rock is covered with an overburden of soil or loose rock, posts shall be set to the minimum depth indicated on the drawing unless a penetration of 18 inches in solid rock is achieved before reaching the indicated depth, in which case depth of penetration shall terminate. All portions of posts set in rock shall be grouted. Portions of posts not set in rock shall be set in concrete from the rock to ground level. Posts set in concrete shall be set in holes not less than the diameter shown on the drawings. Diameters of holes in solid rock shall be at least 1 inch greater than the largest cross section of the post. Concrete and grout shall be thoroughly consolidated around each post, shall be free of voids and finished to form a dome. Concrete and grout shall be allowed to cure for 72 hours prior to attachment of any item to the posts. Group II line posts may be mechanically driven, for temporary fence construction only, if rock is not encountered. Driven posts shall be set to a minimum depth of 3 feet and shall be protected with drive caps when being set. For high security fences, fence post rigidity shall be tested by applying a

50 pound force on the post, perpendicular to the fabric, at 5 feet above ground; post movement measured at the point where the force is applied shall be less than or equal to 3/4 inch from the relaxed position; every tenth post shall be tested for rigidity; when a post fails this test, further tests on the next four posts on either side of the failed post shall be made; all failed posts shall be removed, replaced, and retested at the Contractor's expense.

3.04 RAILS

A. Top Rail

1. Top rail shall be supported at each post to form a continuous brace between terminal posts. Where required, sections of top rail shall be joined using sleeves or couplings that will allow expansion or contraction of the rail. Top rail, if required for high security fence, shall be installed as indicated on the drawings.

B. Bottom Rail

1. The bottom rail shall be bolted to double rail ends and double rail ends shall be securely fastened to the posts. Bolts shall be peened to prevent easy removal. Bottom rail shall be installed before chain link fabric.

3.05 BRACES AND TRUSS RODS

A. Braces and truss rods shall be installed as indicated and in conformance with the standard practice for the fence furnished. Horizontal (compression) braces and diagonal truss (tension) rods shall be installed on fences over 6 feet in height. A center brace or 2 diagonal truss rods shall be installed on 12-foot fences. Braces and truss rods shall extend from terminal posts to line posts. Diagonal braces shall form an angle of approximately 40 to 50 degrees with the horizontal. No bracing is required on fences 6 feet high or less if a top rail is installed.

3.06 TENSION WIRES

A. Tension wires shall be installed along the top and bottom of the fence line and attached to the terminal posts of each stretch of the fence. Top tension wires shall be installed within the top 4 inches of the installed fabric. Bottom tension wire shall be installed within the bottom 6 inches of the installed fabric. Tension wire shall be pulled taut and shall be free of sag.

3.07 CHAIN LINK FABRIC

A. Chain link fabric shall be installed on the side of the post indicated. Fabric shall be attached to terminal posts with stretcher bars and tension bands. Bands shall

be spaced at approximately 15-inch intervals. The fabric shall be installed and pulled taut to provide a smooth and uniform appearance free from sag, without permanently distorting the fabric diamond or reducing the fabric height. Fabric shall be fastened to line posts at approximately 15-inch intervals and fastened to all rails and tension wires at approximately 24-inch intervals. Fabric shall be cut by untwisting and removing pickets. Splicing shall be accomplished by weaving a single picket into the ends of the rolls to be joined. The bottom of the installed fabric shall be 1 plus or minus 1/2 inch above the ground. For high security fence, after the fabric installation is complete, the fabric shall be exercised by applying a 50 pound push-pull force at the center of the fabric between posts; the use of a 30 pound pull at the center of the panel shall cause fabric deflection of not more than 2-1/2 inches when pulling fabric from the post side of the fence; every second fence panel shall meet this requirement; all failed panels shall be resecured and retested at the Contractor's expense.

3.08 GATE INSTALLATION

A. Gates shall be installed at the locations shown on the plans. Hinged gates shall be mounted to swing as indicated. Latches, stops, and keepers shall be installed as required. Rolling gates shall be installed as recommended by the manufacturer. Padlocks shall be attached to gates or gateposts with locking system supplied by manufacturer. Hinge pins, and hardware shall be welded or otherwise secured to prevent removal.

3.09 GROUNDING

A. Fences shall be grounded on each side of all gates, at each corner, at the closest approach to each building located within 50 feet of the fence, and where the fence alignment changes more than 15 degrees. Grounding locations shall not exceed 650 feet. Each gate panel shall be bonded with a flexible bond strap to its gatepost. Fences crossed by power lines of 600 volts or more shall be grounded at or near the point of crossing and at distances not exceeding 150 feet on each side of crossing. Ground conductor shall consist of No. 8 AWG solid copper wire. Grounding electrodes shall be 3/4 inch by 10-foot long copper-clad steel rod. Electrodes shall be driven into the earth so that the top of the electrode is at least 6 inches below the grade. Where driving is impracticable, electrodes shall be buried a minimum of 12 inches deep and radially from the fence. The top of the electrode shall be not less than 2 feet or more than 8 feet from the fence. Ground conductor shall be clamped to the fence and electrodes with bronze grounding clamps to create electrical continuity between fence posts, fence fabric, and ground rods. After installation the total resistance of fence to ground shall not be greater than 25 ohms.

END OF SECTION

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02920 Crop Management

Reed Canary Grass

USE OF GRASSES FOR A LAND WASTEWATER APPLICATION SYSTEM

CHOICE OF GRASS SPECIES

Any adapted grass in the area of use could serve well as a land cover for a wastewater disposal system. On the basis of the potential nitrogen removal and the utilization of harvested grass for hay or silage, a low alkaloid variety of Reed Canary Grass (Phalaris Arundinacea) such as Palaton Reed Canary Grass (Mid-Atlantic Seeds, Inc., York, PA) shall be used.

Reed Canary Grass: The greatest advantage to Reed Canary Grass in the land treatment system is its tolerance to poor drainage and excess water. When grown under proper fertilization and cut at early maturity, it can provide a palatable and nutritious hay or silage. However, in Eastern Pennsylvania, Reed Canary Grass has usually been used almost exclusively in wet, poorly drained areas where other forage crops will not grow. In such cases, it receives little management or fertilization, tends to become coarse, with low palatability, low nutrient value and poor acceptability by animals. This has strongly prejudiced dairymen and horsemen against it as a forage grass. In disposing of Reed Canary grown in a land treatment system, it will be necessary to overcome this prejudice.

Grown under nitrogen fertilization and cut at an early stage of maturity it can be equal to orchard grass in palatability and nutrient value.

Reed Canary Grass has a nitrogen content of 2 to 4% nitrogen, depending on the nitrogen available. It will yield 4 to 6 tons of forage per acre per year for a nitrogen removal of 300 to 400 lbs. per acre. It must be cut frequently and at an early growth stage (well before seed setting) otherwise it becomes coarse and rapidly losses its palatability and nutritious value.

LAND PREPARATION

Soil pH should be checked some six months prior to seeding. It pH is below 6.0, the limestone recommended by the soil test should be applied and plowed in six months before seeding. If the pH is between 6.0 and 6.5, limestone may be broadcast on the surface at any time before seeding. The limestone used should be fine, with 80% or more passing a 100 mesh sieve and have a calcium carbonate equivalent of 95% or more.

Land with weedy and undesirable vegetation should be treated with Round-up herbicide as directed by Township, plowed, disked and smoothed with a spring-tooth or spike-

tooth harrow before seeding. If desirable covers, such as bluegrass, timothy, clover, etc. are already on the land, planting may be done after disking only.

SEEDING

Seeding can be in early spring (March-April) or in late summer (August 15 to September 15). Seeding can be done using the grass seed attachment of a grain drill, by using a broadcast seeder, or any other planter designed for grass seeding. Recommended seeding rates are:

Reed Canary Grass: 30 lbs/acre

Use the seed stock commonly available in the local seed trade. Add 1 pound Ladino clover and 2 pounds Alsike clover for better quality hay or silage.

If seeding is on plowed and disked land, allow one week after plowing before seeding to allow the seed bed to settle. Application of 1/2" to 3/4" of water before seeding will help the- seedbed to settle and provide moisture for rapid germination. After seeding on newly plowed, land, firm the seed into the soil with a corrugated roller. On disked land, broadcast the seed into the existing cover.

Whether on plowed or disked land, apply 1/2" to 3/4" of water to insure rapid germination. Repeat at weekly intervals until stand is well established at which time water application may be increased.

Nitrogen is usually applied to grasses at seeding. In this case, no nitrogen is recommended at seeding as the nitrogen in the light application of treated wastewater should provide the needed nitrogen.

FERTILIZATION

The fertilizer rate for these grasses, both at seeding and later for maintenance, is as follows:

Soil Test Level	P lbs./acre	K Lbs./acre
L	120	180
M	60	100
H	0	60

Seeding Fertilization:

Base seeding fertilization on the soil test results of the sample taken 6 months before seeding or on a sample taken at seeding time. If the P soil test is low, broadcast and plow down P and K before seeding. Otherwise (M or H soil test) broadcast P and K before seeding.

Maintenance Fertilization:

Obtain soil sample for soil testing in early spring (February and March). Broadcast recommended P in spring. Broadcast up to 100 lbs. K in spring at same time as P. If amounts of K recommended are over 100 lbs., broadcast amounts recommended over 100 lbs. after the first cutting. Monitor soil pH yearly and apply limestone as recommended if pH fails below 6.0.

HARVEST OF FORAGE

The forage shall be ready for the first harvest about 8 to 9 weeks after spring seeding or in April after a fall seeding.

Subsequent harvest should be made when the grass is 12 to 15 inches tall and before seed heads begin to form. Cuttings can be expected at 40 to 50 day intervals. Actual harvesting schedules will need to be based on on-site evaluation as the growth rate can be strongly modified by the amount of nitrogen and water applied, as well as climatic conditions.

Early harvest of the grass (before seed set) will result in higher nitrogen removal and better forage quality.

MANAGEMENT

Reed Canary grass requires little management. The main management concern is that cutting be frequent enough to prevent rank and coarse growth. The stand should persist for a long time without reseeding. Should the stand become thin, it can be reseeded by broadcasting seed after disking. Plowing to reseed should be needed only if the stand becomes excessively weedy.

NITROGEN REMOVALS

Actual nitrogen removals should be based on a nitrogen analysis of each forage cutting and a determination of the amount of forage removed.

Nitrogen removals will be greatest when the forage is cut frequently at an early stage of growth. Estimated nitrogen removals are as follows:

January and December	0
February and November	10 lbs./acre
March and October	20 lbs./acre
April to September	40 lbs./acre
Total	300 lbs./acre

These estimates are probably on the conservative side, especially for Reed Canary Grass. They are based on four cuttings of 2,500 lbs. of forage with a 3% nitrogen content. A

combination of higher nitrogen content and higher forage yields could raise the nitrogen removal to 400 lbs. per acre per year or over.

END OF SECTION

SECTION 02937

SITE RESTORATION

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish erosion control measures, finish grading, apply lime and fertilizer, apply seed and mulch, and maintain all restored areas as shown on the Drawings and as specified herein including all areas disturbed by the Contractor.

B. Restoration is divided into four areas: 1) field areas, 2) general site restoration area which includes lagoon, building, paved and access road areas, 3) wildflower areas, and 4) wooded areas

1.02 DEFINITIONS

A. Noxious Weeds (for grass seeding): Includes Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwork, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wil Garlic, Perennial Sorrel, and Brome Grass (and others as may be found in Township Ordinances).

1.03 REGULATORY REQUIREMENTS

A. Conform to requirements of the latest edition of the Pennsylvania Department of Transportation Standard Specifications for Construction and Materials and applicable permit requirements.

B. Comply with regulatory agencies for fertilizer composition and application.

C. Comply with Township Subdivision and Land Development Ordinance as amended.

1.04 TESTS

A. Provide analysis of topsoil under provisions of Section 01400.

B. Analyze for phosphorus, magnesium, potassium, soluble salt content, organic matter content, and pH value.

C. Soil tests shall be conducted by a state laboratory or recognized commercial laboratory. Contractor shall perform a minimum of one soil test in each of four restoration areas (for a total minimum of four tests) using representative samples of on-site soils for each area. Engineer may require more samples on large areas.

1.05 SUBMITTALS

A. Samples of all materials shall be submitted for inspection and acceptance upon Engineer's request.

B. Contractor shall provide the Owner with Vendor's packaging tags from all seed and fertilizer with certified statement of weight, composition, mixture, percentage of purity, and germination as verification that the proper materials and volumes have been used.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver products to site under provisions of Section 01600.

B. Store and protect products under provisions of Section 01600.

C. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable.

D. Deliver fertilizer in original, unopened waterproof bags showing weight, chemical analysis, trade name or trademark of manufacturer, warranty of the manufacturer in accordance with applicable state fertilizer laws.

1.07 MAINTENANCE

A. Maintain seeded areas immediately after placement and until final completion.

PART 2 PRODUCTS

2.01 QUALITY ASSURANCE

A. Manufacturer's certified analysis shall accompany packaged standard products.

2.02 TOPSOIL

A. The results of the topsoil testing shall be submitted to the Owner based on the following analysis.

Acceptable Soil Test Results

pH range	6.0 - 7.0
Organic matter	1.5 - 3.0%
Magnesium - Mg	35 lbs./acre
Phosphorus - P205	100 lbs./acre
Potassium - K20	85 lbs./acre
Soluble salts	not to exceed 500 ppm

B. Based on test performed by the laboratory, the topsoil shall be identified as acceptable or acceptable with certain fertilizer and limestone applications. The fertilizer and lime requirements will be as recommended by the laboratory.

C. Topsoil shall be fertile, friable, natural topsoil. It shall be without admixture of subsoil or slag and free of stones, lumps, plants or their roots, sticks, peat and other extraneous matter and shall not be delivered or used while in frozen or muddy condition.

2.03 SEED MIXTURES

A. Grass Seed Mixture (General Site Restoration)

1. Grass Seed Mixture (General Site Restoration)

Seed Mix	% by Weight
Lofts tri-plex ryegrass	50% Palmer
	25% Yorkstowne III
	25% Repell

2. The date of the last germination of the seed shall be within a period of 6 months prior to commencement of planting operations. Seed shall be from same of previous year's crop; each variety of seed shall have a purity of not less than 85%, a percentage of germination not less than 90%, shall have a weed content of not more than 1% and contain no noxious weeds.

B. FERTILIZER

1. All fertilizers shall be uniform in composition, free flowing and suitable for application with approved equipment.

2. Fifty percent of the elements shall be derived from organic sources; and be proportion necessary to eliminate any deficiencies of topsoil as indicated by soil test.

C. LIME

1. Lime material shall be ground or peletized limestone, which contains at least 85% calcium and magnesium carbonates. Limestone shall be ground to such fineness that at least 50% will pass through a 100-mesh sieve and 90% shall pass a 20-mesh sieve. Application rates for liming materials shall be as determined by soil tests.

D. WILDFLOWER MIXTURE

1. Wildflower meadow mixture shall be Lofts Wildflower Meadow mixture or approved equal.

Seed Mix	% by Weight
Hard Fescue	87%
Pinto Northern	
Wildflower Mixture	13%

2. Fertilizer shall be used only if the topsoil is infertile as determined by soil test. If needed a 5-10-10 or other low nitrogen fertilizer should be used.

E. HAY CROP MIXTURE

1. Hay crop mixture shall be as follows (where reed canary grass is specified):

Seed Mix	% by Weight
Palation reed canary grass 99.81% seed (low alkaloid content)	96
Ladino Clover	4

Other hay crop seeds will be specified in contract documents as they appear

2. Soil Amendment Material

   a. Lime: Ground limestone, dolomite type, minimum 95% calcium carbonate equivalent, minimum 80% passing a 100 mesh sieve.

   b. Fertilizer: FS 0-F-241 with minimum 30% organic, of proportions based on soil analysis.

2.04 MULCH

A. Mulching material shall be oat or wheat straw, free from weeds, foreign matter detrimental to plant life. Hay or chopped cornstalks are not acceptable.

B. Synthetic binder for mulch shall be Terratack or approved equal.

2.05 WATER

A. Clean, fresh and free of substances or matter which could inhibit vigorous growth of grass. The Contractor is responsible for watering and maintenance of seeded areas until final completion. Water source must be approved by Township and Engineer.

PART 3 EXECUTION

3.01 APPLICATION

A. Unless otherwise shown on the Drawings, permanent stabilization will be applied to all disturbed areas within 10 days of reaching final grade. Topsoil shall be placed to a minimum depth of 4" in disturbed areas.

3.02 SEEDBED PREPARATION

A. Grass seed and wildflower seed

1. Previously established grades as shown on Drawings shall be maintained in a true and even condition.

2. Subgrade shall be prepared by tilling prior to placement of topsoil to obtain a more satisfactory bond between the two layers. Tillage operations shall be across the slope. Tillage shall not take place on slopes steeper than 2 horizontal to 1 vertical or where tillage equipment cannot be operated. Tillage shall be accomplished by disking or harrowing to a depth of 9 inches parallel to contours. Tillage shall not be

performed when the subgrade is frozen, excessively wet, extremely dry or in other conditions which would not permit tillage. The subgrade shall be raked and all rubbish, sticks, roots and stones larger than 2-in shall be removed. Subgrade surfaces shall be raked or otherwise loosened immediately prior to being covered with topsoil.

3. Topsoil shall be placed over approved areas to a depth sufficiently greater than required so that after natural settlement and light rolling, the completed work will conform to the lines, grades, and elevations indicated. No topsoil shall be spread in water or while frozen or muddy.

4. After topsoil has been spread, it shall be carefully prepared by scarifying or harrowing and hand raking. All stiff clods, lumps, roots, litter and other foreign material shall be removed from the topsoiled area and disposed of by the Contractor. The areas shall also be free of smaller stones, in excessive quantities. The whole surface shall then be rolled with a hand roller weighing not more than 100 pounds per foot of width. During the rolling, all depressions caused by settlement or rolling shall be filled with additional topsoil and the surface shall be regraded and rolled until a smooth and even finished grade is created.

B. Hay Crop

1. Hay crop areas (generally spray fields) shall be sub-soiled to relieve compaction, mold board plowed, disked and smoothed with a spring tooth or spiketooth harrow and cultipacked one week before seeding.

2. Apply 1/2 inch to 3/4 inch of water or allow one rainfall prior to seeding to help settle the seedbed.

3. If reed canary grass is used, follow specification section 02920

3.03 LIMING AND FERTILIZING

A. Grass Seed and Wildflowers Mixture

1. After the topsoil is placed and before it is raked and rolled, limestone shall be spread evenly over the surface and thoroughly incorporated by heavy raking to al least one half the depth of topsoil. Application rates for liming materials shall be as determined by soil test.

2. Apply fertilizer in accordance with manufacturer's instructions.

3. Apply grass seed mixture at a rate of 7 (seven) pounds per l000 square feet or 300 pounds per acre. Wildflower seed mixture shall be applied at a rate of 50 (fifty) pounds/acre. Apply grass seed mixture with either a broadcast spreader, grain drill or slit seeder. Apply Wildflower seed mixture with drop or cyclone spreader. Rake in lightly. Do not seed area in excess of that which can be mulched on same day. Apply seed in two different directions for best coverage. Hydroseeding will not be permitted unless approved by engineer on steep slopes for erosion control.

4. Grass seed planting season is April 1 to October 15. Wildflower seed planting season is March 15 to June 15 or August 15 to October 15.

5. Lightly water to aid the dissipation of fertilizer.

B. Hay Crop

1. If soil test level of potassium or phosphorus is low, broadcast potassium and phosphorus at recommended rates before plowing. Otherwise (medium or high potassium and phosphorus levels) broadcast potassium and phosphorus at recommended rates before seeding.

2. Potassium and phosphorus fertilizer shall be added, plowed in at 0-20-20 lbs./acre.

3. Nitrogen shall not be applied to irrigation areas unless essential to crop propagation.

3.04 SEEDING, PLANTING, PRUNING & MULCHING

A. Grass Seed and Wildflower Mixture

1. Contractor shall proceed only after topsoil or subsoil has been prepared uniformly in the designated areas to within 2/10 of one inch. Any undulations or irregularities in the surface resulting from fertilizing, liming, tilling or other causes shall be leveled prior to seeding. Flooded, washed out or areas otherwise damaged shall be reconstructed and all grades re-established by the Contractor in accordance with the drawings and/or other applicable specifications.

2. Prior to seeding, the surface shall be cleared of all trash, debris and stones larger than 1 1/2 inches in diameter or length, and of all roots, brush, wire, grade stakes and other objects that would interfere with seeding operations.

3. Apply grass seed at a rate of 5 (five) pounds per 1000 square feet or 210 pounds per acre. Wildflower seed shall be applied at a rate of 50 (fifty) pounds/acre. A cover crop may be required as directed by Township. Rake in lightly. Do not seed area in excess of that which can be mulched on same day. Apply seed mixture with either a broadcast spreader, slit seeder or grain drill. Apply in two different directions for best coverage. Hydroseeding will not be permitted unless approved by engineer on steep slopes for erosion control.

4. Refer to permanent seeding table for planting seasons for each seed mixture.

5. Do not sow immediately following rain, when ground is too dry, or during windy periods.

6. Roll seeded area with roller not exceeding 112 lbs.

7. Immediately following seeding and compacting, apply mulch at a rate of 1-1/2 to 2 tons/acre to grass seed mixture areas. Maintain clear of shrubs and trees. Secure mulch with synthetic binder as recommended by manufacturer. Wildflower

mixture areas shall not receive mulch or binder.

8. Apply water with a fine spray immediately after each area has been mulched. Saturate to 4 inches of soil.

B. Hay Crop Seeding

1. Seeding shall take place in early spring March 15 (providing risk of freezing or frost has passed) to April 20 or in late summer August 1 to September 10.

2. A grain drill is the preferred seeding device. Hydroseeding shall not be allowed.

3. Seed shall be evenly applied at a rate of 30 (thirty) pounds of seed per acre. A cover crop may be required as directed by Township

3. Seed shall be placed by a person familiar with hay crop production (refer to section 02920 – Crop Management reed canary grass.

C. Wooded Areas

1. Wooded areas shall be cleared of all dead wood – standing and fallen after construction.

2. Wooded area restoration is subject to best Forestry Management Practices as contained in various publications of the Pa. DCNR, Delaware Valley College Forestry Department and others as referenced in site-specific applications.

3.05 MAINTENANCE

A. Grass Mixture

1. Mow grass at regular intervals to maintain at a maximum height of 2 -1/2 inches. Do not cut more than 1/3 of grass blade at any one mowing.

2. Neatly trim edges and hand clip where necessary.

3. Immediately remove clippings after mowing and trimming.

4. Water to prevent grass and soil from drying out.

5. Control growth of weeds. If necessary, apply herbicides in accordance with manufacturer's instructions.

6. Immediately reseed areas which show bare spots.

B. Wildflower Mixture

1. Mow wildflower areas three times in one season at 12-15", above the height of the wildflowers.

2. Water seeded area to prevent wildflowers and soil from drying out.

3.06 GUARANTEE PERIOD AND FINAL ACCEPTANCE

A. All restored areas shall be guaranteed by the Contractor for not less than one full year from the time of final completion.

B. At the end of the guarantee period restored areas not demonstrating satisfactory stands shall be renovated, reseeded, replanted or further pruned and trimmed and maintained meeting all requirements as specified herein.

C. A satisfactory grass stand shall be defined as an even stand of grass 2" tall with 85% germination.

END OF SECTION

SECTION 02938

SPRAY FIELD RESTORATION

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish finish grading, apply lime and fertilizer, apply seed and mulch, and maintain all restored areas as shown on the Drawings and as specified herein including all areas disturbed by the Contractor.

1.02 DEFINITIONS

A. Noxious Weeds (for grass seeding): Includes Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwork, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wil Garlic, Perennial Sorrel.

1.03 REGULATORY REQUIREMENTS

A. Comply with regulatory agencies for fertilizer composition and application.

1.04 TESTS

A. Provide analysis of topsoil under provisions of Section 01400.

B. Analyze for phosphorus, magnesium, calcium, potassium, soluble salt content, organic matter content, and pH value.

C. Soil tests shall be conducted by a state laboratory or recognized commercial laboratory. Contractor shall perform one soil test in each of spray field areas using representative samples of on-site soils for each area.

1.05 SUBMITTALS

A. Samples of all materials shall be submitted for inspection and acceptance upon Engineer's request.

B. Contractor shall provide the Owner with Vendor's packaging tags from all seed and fertilizer with certified statement of weight, composition, mixture, percentage of purity, and germination as verification that the proper materials and volumes have been used.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver products to site under provisions of Section 01600.

B. Store and protect products under provisions of Section 01600.

C. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not

acceptable.

D. Deliver fertilizer in original, unopened waterproof bags showing weight, chemical analysis, trade name or trademark of manufacturer, warranty of the manufacturer in accordance with applicable state fertilizer laws.

1.07 MAINTENANCE

A. Maintain seeded areas immediately after placement and until final completion.

PART 2 PRODUCTS

2.01 QUALITY ASSURANCE

A. Manufacturer's certified analysis shall accompany packaged standard products.

2.02 SOIL TESTING

A. A soil test shall be taken and lime and nutrients applied prior to chisel plowing to one foot. The results of the soil testing shall be submitted to the Owner based on the following analysis.

Acceptable Soil Test Results

pH range	6.5 - 7.0
Organic matter	1.5 - 3.0%
Magnesium - MgO	140 - 600
Phosphorus - P205	140 - 230
Potassium - K20	130 - 460
Soluble salts	< 0.4 mmhos/cm
2=1 water to soil	Electrical Conductivity

B. Based on test performed by the laboratory, the topsoil shall be identified as acceptable or acceptable with certain fertilizer and limestone applications. The fertilizer and lime requirements will be as recommended by the laboratory.

C. If topsoil must be added it shall be fertile, friable, natural topsoil. It shall be without admixture of subsoil or slag and free of stones, lumps, plants or their roots, sticks, peat and other extraneous matter and shall not be delivered or used while in frozen or muddy condition.

2.03 SEED MIXTURES

A. Hay crop mixture shall be as follows (Engineer will specify seed mix):

Seed Mix	If Seeded Alone
Reed Canarygrass – Certified seed of a variety acceptable for hay production	20 lbs./ac
Timothy – Certified seed of a variety acceptable for hay production	15 lbs./ac
Orchardgrass – Certified seed of a variety acceptable for hay production	15 lbs./ac

B. Soil Amendment Material

1. Lime: Agricultural limestone complying with the agricultural lime law in Pennsylvania and approved by the PA Dept. of Agriculture.

2. Fertilizer: Agricultural grade fertilizer meeting specifications required under the Pennsylvania lime and fertilizer regulations.

2.04 MULCH

A. Mulching material shall be oat, wheat or rye, straw, free from weeds, foreign matter detrimental to plant life. Hay or chopped cornstalks are not acceptable.

2.05 WATER

A. Clean, fresh and free of substances or matter that could inhibit vigorous growth of grass. The Contractor is responsible for watering and maintenance of seeded areas until final completion.

PART 3 EXECUTION

3.01 PRELIMINARY INVESTIGATION

A. Walk the site and determine areas that are severely compacted vs. areas that are slightly or moderately compacted. Severely compacted would be areas of constant equipment traffic or by soil examination compaction was deeper than about 1 foot beneath the surface. Moderately compacted or slightly compacted would be areas where some equipment traffic occurred or compaction by examination of the soil was less than 1 foot.

B. Confirm via survey that sprayfield is installed with correct contours and terraces and that storm water originating from offsite is directed away from, under or around the sprayfield and/or spray irrigation area.

3.02 SEEDBED PREPARATION

A. Severely Compacted Areas

1. Severely or Moderately compacted areas should be sub soiled to 24 inches. These sites should then be chisel plowed to a depth of 1 foot if recommended by the soil consultant.

B. Organic Matter Replacement

1. Organic matter if required should be applied before chisel plowing.

2. Sources of organic matter could be various types of compost. Compost must be approved by Engineer or soil consultant before application.

C. Initial Watering

1. Apply 1/2 inch to 3/4 inch of water or allow one rainfall prior to seeding to help settle the seedbed.

3.03 LIMING AND FERTILIZING

A. Application of plow down and starter fertilizer should follow the recommendations of the soil test laboratory. If recommendations for application methods and amounts are not provided by the laboratory, an agronomist should develop the procedures to be followed based on soil test results.

B. Potassium and phosphorus fertilizer shall be added, plowed in at 0-20-20 lbs./acre.

C. Nitrogen fertilizer shall be a light application (10 pounds per acre) for crop establishment.

3.04 SEEDING & MULCHING

A. Seeding shall take place in early spring March 1 to April 20 or in late summer August 25 to September 30.

B. A Grain Drill is the preferred seeding device. Hydroseeding shall not be allowed.

C. Seed rate shall be approved by Engineer.

D. Seed shall be placed by a person familiar with haycrop production.

E. The cover crop should have straw mulch placed over the soil surface.

3.05 GUARANTEE PERIOD AND FINAL ACCEPTANCE

A. All restored areas shall be guaranteed by the Contractor for not less than one full year from the time of final completion.

B. At the end of the guarantee period restored areas not demonstrating satisfactory stands shall be renovated, reseeded, and maintained meeting all requirements as specified herein.

C. A satisfactory stand shall be defined as an even stand of grass 2" tall with 85% germination.

END OF SECTION

DIVISION 3

CONCRETE

Castle Valley Consultants, Inc.
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SECTION 03300

CONCRETE

PART 1 GENERAL

1.01 WORK INCLUDES

A. Structural and miscellaneous concrete.

B. Concrete reinforcement and accessories.

C. Footing and foundations.

D. Slabs.

1.02 CODES AND STANDARDS

A. Except as modified by the requirements specified herein and/or the details on the Drawings, all work included in this section shall conform to the applicable provisions of the following codes and standards:

1. ACI 211.1 - Recommended Practice for Selecting Proportions for Normal and Heavy Weight Concrete
2. ASTM C260 - Air Entraining Admixture for Concrete
3. ACI 301 -Specifications for Structural Concrete for Buildings. The Contractor shall have one copy of ACI 301 available for reference on the work site at all times.
4. ANSI/ASTM A185 - Welded Steel Wire Fabric for Concrete Reinforcement
5. ANSI/ASTM A497 - Welded Deformed Steel Wire Fabric for Concrete Reinforcement
6. ASTM A615 - Deformed and Plain Billet-Steel for Concrete Reinforcement
7. ASTM C33 - Concrete Aggregates
8. ASTM C150 - Portland Cement
9. ACI-304 - Recommended Practice for Measuring, Mixing, and Placing Concrete
10. ACI-305 - Recommended Practice for Hot Weather Concreting
11. ACI-306 - Recommended Practice for Cold Weather Concreting
12. ACI-311 - Manual of Concrete Inspection
13. ACI-315 - Manual of Standard Practice for Detailing Reinforced Concrete

14. ACI-318 - Building Code Requirements for Reinforced Concrete

15. ASTM C-94 - Ready Mixed Concrete

16. ASTM Standards C143, C31, C173, C231, C172 and C39

17. ACI-350 - Concrete Sanitary Engineering Structures

18. ASTM D2103 - Polyethylene Film and Sheeting

B. Definitions:

1. ACI - American Concrete Institute,

   P. O. Box 19150, Detroit, Michigan 43219

2. ASTM - American Society for Testing Materials

3. CRSI - Concrete Reinforcing Steel Institute,

   228 N. LaSalle Street, Chicago, IL 60601

1.03 QUALITY ASSURANCE

A. Perform work in accordance with ACI 301.

B. Maintain copy of ACI 301 on site.

C. Testing Agency:

1. An independent testing agency selected by the Contractor, subject to the approval of the Engineer.

1.04 TESTS

A. Testing and analysis of concrete will be performed under provisions of Section 01400.

B. Submit proposed mix design to Engineer for review prior to commencement of work.

C. Concrete shall be sampled and tested for quality control during the placement of concrete as follows:

1. Sampling fresh concrete: ASTM C172, except modified for slump to comply with ASTM C94.

2. Slump: ASTM C143 one test for each concrete load at point of discharge, after the addition of water to the mix, for each set of compressive strength test specimens.

3. Air content: ASTM C231 pressure method; one for each set of compressive strength test specimens.

4. Compression test specimens: ASTM C31 one set of 4 standard cylinders for each compressive strength test.

5. Compressive strength tests: ASTM C39, one set for each pour in any one day; number of sets in accordance with ACI 318. one cylinder tested at seven days and balance at 28 days.

6. One additional test cylinder will be taken during cold weather and be cured on site under same conditions as concrete it represents.

7. Temperature: One test for each concrete load at point of discharge, after addition of water to the mix, for each set of compressive strength test specimens.

D. Cost of testing: The cost of initial testing is borne by the Contractor. All follow-up testing which results from a failed initial test is borne by the Contractor.

E. Report test results in writing to the Engineer. All reports shall contain project identification name and number, date of concrete placement, name of Contractor, name of concrete supplier, name of concrete testing service and test results.

F. Evaluation of Test Reports:

1. Evaluation of test reports: ACI 301-72, Chapter 17.

2. Tests showing non-conformance to specifications:

- Engineer may order core boring or load tests to be made.

- Cost of additional tests for evaluation of non-conforming materials: Borne by Contractor.

1.05 GENERAL DESCRIPTION OF WORK

A. Work shall not proceed until all design mixes have been approved in writing by the ENGINEER.

B. Except as specified otherwise herein, concrete shall be batched, mixed, placed, tested, and cured in accordance with the American Concrete Institute and other applicable Codes.

C. Normal weight concrete shall weigh in place not more than 145 pounds per cubic foot.

D. Contractor shall schedule his work and notify all trades in ample time so that provision for their work can be made without delaying the progress of the project.

E. It is the intention of the Drawings and Specifications to produce watertight concrete that will present an acceptable finish appearance. Imperfection of materials or workmanship shall be corrected as the Engineer directs at the Contractor's expense.

F. It will be the Contractor's responsibility to ensure that all concrete surfaces are completely free of any conditions, which will adversely affect its finished appearance, watertightness, or the application of a specified finish.

1.06 ENVIRONMENTAL CONDITIONS

A. Cold weather requirements:

1. Concrete shall not be mixed or placed when the air temperature is below 40 degrees F or when conditions indicate that the temperature will fall below 40 degrees F within 72 hours.

2. Concrete temperature shall be maintained when deposited at not less than 60 degrees F. In cold weather, the reinforcement, forms, and ground, which will contact must be completely free of frost.

B. Hot weather requirements:

1. The maximum placing temperature of the concrete, when deposited, shall be 85 degrees F. If the weather causes the placing temperature to exceed 85 degrees F, the mix shall be cooled by wetting the aggregate or other appropriate method if approved by the Engineer. The additional cost of such cooling methods shall be borne by the Contractor.

1.07 SUBMITTALS

A. General: Make submittals in accordance with the requirements to Section 01400 of these Specifications.

B Certification: ASTM C94, Section 15.

C. Test reports: Certified copies of laboratory test reports, including tests on aggregate and admixtures. These tests shall be made by a approved commercial laboratory or by a laboratory maintained by the manufacturers of the material.

D. Manufacturer's Data: All materials.

E. Concrete reinforcement: ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures".

PART 2 PRODUCTS

2.01. MATERIALS

A. Water: Clean and free of organic materials, strong acids or alkalis, oils and salt.

B. Portland Cement ASTM-C150, Type I, American manufacture. One (1) brand used throughout project.

C. Sand (Fine aggregate) shall be clean, sharp, coarse, (minimum fines) hard, natural sand free from salt, loam, clay and other deleterious materials and shall conform to ASTM Specification C33 or C330.

D. Coarse Aggregate: Shall be well-graded, washed gravel or crushed stone and shall conform to ASTM Specification C33 for normal weight aggregate. Maximum size 3/4".

E. Reinforcing Steel: Reinforcing bars shall be deformed high strength bars conforming to ASTM A615, Grade 60.

F. Welded Wire Fabric: Shall conform to ASTM A185-73 Standard Specifications for Welded Steel Wire Fabric for Concrete Reinforcement.

G. Concrete Admixtures: Concrete admixtures shall be used to facilitate concrete placement, difficult placing conditions or assist in attaining specified concrete qualities. Admixtures shall have less than 0.05% chloride ions.

1. Air Entrainment per ASTM C260
2. Water Reducer per ASTM C494, Type A
3. Water Reducer/Accelerator per ASTM C494, Type C or E
4. Water Reducer/Retarder per ASTM C494, Type B or D
5. Superplasticizer per ASTM C494, Type F or G

Xpex waterproofing admixture shall be used in all concrete. Handle and dispense in accordance with the strictest provision of the manufacturer.

H. Forms: Wood, metal, or fiber type.

I. Curing Materials: Waterproof paper, mats, burlap or polyethylene film.

J. Waterstop: 6" x 3/8", Ribbed with center bulb. PVC waterstop as manufactured by Vinylex Corporation, or approved equal.

K. Splicing shall be heat fused per manufacturer's recommendations.

L. Preformed Bituminous Joint: Shall conform to ASTM D994.Expansion Bolts: Shall be as follows (bolts, washers, and nuts shall be made of 304L stainless steel unless noted otherwise):

Trade Designation	Manufacturer
Star Slugin	Star Expansion Co. Mountainville, NY 10953

Rawl Multi-Calk	The Rawlplug Co. 224 Peterson Road New Rochelle, NY 10802
Kwik-Bolt	Hilti Fastening Systems One Cummings Point Road Stamford, CT 06904
Expansive Screw Anchor	Ackerman-Johnson Co. 99 Commercial Drive Addison, IL 60101
Phillips Red Head Self Drilling Concrete Anchor	Phillips Drill Co. U.S. 12 and Liberty Trail Michigan City, IN 46360
Wej-IT	Wej-IT Corporation 500 Alter Street Broomfield, CO 80020
Cinch Expansion Anchor	Anchor Alloys, Inc. 966 Meeker Avenue Brooklyn, NY 11222

M. Adhesive Anchors System: Shall be as follows (bolts, washers, and nuts shall be made of 304L stainless steel unless noted otherwise)

Trade Designation	Manufacturer
Redi-Chem Concrete Anchor System	Phillips Drill Co. U.S. 12 and Liberty Trail Michigan City, IN 46360
Rawl Chem-Stud Anchor System	The Rawlplug Co. 224 Peterson Road New Rochelle, NY 10802
HVA Adhesive	Hilti Fastening Systems One Cummings Point Road Stamford, CT 06904

N. Anchor Bolts: Shall conform to ASTM A 307.

O. Vapor barrier: Polyethylene film .006" thick, lapped 12" at laps.

P. Grout: Shall be nonshrink grout; Embeco No. 636 or Masterflow No. 713 as manufactured by Master Builder or an approved equal.

Q. Hardener: Master Builder's "Saniseal 100"; Sonneborn's "Lapidolith"' A.C. Horn's "Hornolith" or an approved equal. Include sealer as recommended by hardener manufacturer.

R. Epoxy Grout: Sikadur 32, high-mod, high-strength epoxy bonding/grouting adhesive.

S. Concrete Strengths: Minimum ultimate compressive strength of the concrete at age 28 days shall be 4000 pounds per square inch and the slump shall not exceed 4".

2.02 CONCRETE MIXES AND STRENGTHS

A. Concrete mixes shall be proportioned per section 3.9 of ACI-309. Certified historical test data shall serve as a basis for each mix design. Deviations shall be

substantiated with additional certified trial mix testing and results. Submit mix design, historical data or trial mix results for approval prior to proceeding with the work.

PART 3 EXECUTION

3.01. REINFORCEMENT

A. Fabricated to shapes and dimensions indicated. Before placing, clean rust mill scale or coating, including ice that would destroy or reduce bond from surface.

B. Reinforcement shall not be bent or straightened in a manner injurious to the material.

C. Splices at maximum stress not permitted. Laps and splices shall be of adequate length to transmit stresses. Splices in adjacent bars shall be staggered.

D. Steel reinforcement shall be covered with concrete in accordance with the drawings and/or ACI 350.

E. Wire reinforcement shall be cut and supported at proper elevations by standard accessories.

F. Dovetail anchors, bolts, bars, pipes and dowels shall be accurately and securely tied.

G. Reinforcement shall be secured in position and reviewed by the Engineer before pouring of concrete.

H. Welding of reinforcing steel not permitted.

3.02 FORMS

A. Forms shall be constructed to conform to shape, form, line and elevation required and shall be sufficiently rigid to prevent deformation under load. Forms and supports shall not be removed until members, walls, etc., have acquired sufficient strength to safely support their weight and any load thereon.

B. Forms shall be sufficiently tight to prevent leakage of the concrete.

C. Forms for concrete that will be exposed shall be made of smooth plywood or tempered wood fiberboard or steel in large sheets with close fitting joints and surfaces treated with plastic coating.

D. Do not apply form release agent where concrete surfaces receive special finishes or applied coatings, which may be affected by agent.

3.03 CONCRETE

A. Certificates shall be furnished to the Engineer showing that the concrete and reinforcement complies with tests and samples of applicable specifications.

B. Base shall be level and true and covered with vapor barrier to receive concrete slabs. Lap vapor barrier 12". Top lap placed in direction of concrete spreading.

C. Forms shall be clean and free from shavings, debris and frost.

D. Care shall be exercised to prevent honeycombing or segregation of the ingredients of the concrete.

E. Consolidate structural concrete with mechanical vibrators.

F. Finishes:

1. Slight honeycomb and minor defects shall be patched with cement mortar of 1 part cement to 2 parts sand.

2. Finishes:

- Broom finish for walkways: ACI 301, Ch. 11, Para. 11.7.4, broom or belt finish

- Concrete floors: ACI 301, Ch. 10, Steel float

- Walls: ACI 301, Ch. 10, Para. 10.3.2, grouted, cleaned finish

3.04 PROTECTION AND CURING

A. The protection used for curing shall remain in place at least 24 hours or for sufficient time to ensure development of specified strength.

B. Curing compounds shall not be used.

C. Protect exposed concrete from damage for duration of construction.

3.05 EMBEDDED ITEMS

A. Set and build into the work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. This includes bolts, expansion bolts, pipes, etc.

3.06 EXISTING CONCRETE MODIFICATIONS

A. Where new concrete reinforcement is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack with epoxy grout.

B. Prepare existing placed concrete by cleaning with steel brush and apply bonding agent in accordance with manufacturer's instructions prior to placement of new concrete.

3.07 SLABS (ACI 301-72 Chapter 11)

A. All slabs shall be in accordance with ACI 301-72 Chapter 11 and these specifications.

3.08 PROPORTIONING (ACI 301-72 Chapter 3)

A. All concrete shall be proportioned to resist destructive exposure.

B. All concrete structures shall be watertight.

3.09 MISCELLANEOUS CONCRETE ITEMS

A. Install all items, such as concrete hardener, bolts, grout, expansion bolts, performed bituminous joint, etc. in strict accordance with manufacturer' written instructions.

END OF SECTION

SECTION 03400

PRECAST CONCRETE STRUCTURES

PART 1 GENERAL

1.01 WORK INCLUDES

A. Precast concrete structures.

1.02 REFERENCES

A. The most stringent code shall govern

1. ACI 301 - Structural Concrete for Buildings.
2. ACI 318 - Building Code Requirements for Reinforced Concrete.
3. ACI 350 R - Concrete Sanitary Engineering Structures.
4. ASTM A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
5. ASTM A185 - Welded Steel Wire Fabric for Concrete Reinforcement.
6. ASTM A307 - Specification for Low-Carbon Steel Externally and Internally Threaded Standard Fasteners.
7. ASTM A325 - Specification for High Strength Bolts for Structural Steel Joints, Including Suitable Nuts and Plain Hardened Washers.
8. ASTM A4l6 - Uncoated seven-wire stress-relieved strand for prestressed concrete.
9. ASTM A615 - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
10. ASTM C33 - Concrete Aggregates.
11. ASTM C94 - Ready Mixed Concrete.
12. ACI 304 - Recommended Practice for Measuring, Mixing, and Placing Concrete.
13. ACI 311 - Manual of Concrete Inspection.
14. ACI 315 - Manual of Standard Practice for Detailing Reinforced Concrete.
15. ASTM C150 - Portland Cement.
16. ASTM C260 - Air Entraining Admixtures for Concrete.
17. ASTM C330 - Lightweight Aggregates for Structural Concrete.
18. ASTM C494 - Chemical Admixtures for Concrete.
19. PCI MNL-116 - Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products.

20. PCI MNL-120 - Design Handbook - Precast and Prestressed Concrete.

21. PCI MNL-123 - Manual on Design of Connections for Precast Prestressed Concrete.

22. PCI MNL-127 - Manual on Recommended Practice for Erection of Precast Concrete.

23. Concrete Reinforcing Steel Institute (CRSI), "Manual of Standard Practice."

1.03 STRUCTURAL DESIGN REQUIREMENTS

A. The Contractor shall address all anticipated loading conditions as indicated on the Drawings, as specified herein, and as required by local and State building codes. All load cases shall be considered and the design shall be based on the governing cases, which produce the greatest stresses on the structure. Load cases to be addressed include: tanks empty with saturated soil outside, tanks full with saturated soil outside, tanks full with dry soil outside and tanks full with no soil pressure outside.

B. Maximum ground water elevation shall be assumed to be at finish grade level. Saturated soil shall be assumed to exert a minimum equivalent fluid pressure of 90 pcf. onto the structure.

C. All structures shall be designed to resist buoyancy when empty.

D. Effects on all vertical, horizontal and lifting loads anticipated on the finished structure shall be included in the analysis and design. Loading from piping and equipment, snow, 150 p.s.f. floor live load shall be included.

E. All structures shall be watertight.

F. Where conditions arise which are not specifically covered by these notes and specifications, the Current Standards of ACI 301, 304, 306, 311, 315, 318, 350, and ASTM C94 shall govern.

1.04 SUBMITTALS

A. Submit Shop Drawings under provisions of Section 01300.

B. Submit design calculations and Shop Drawings indicating fabrication details, reinforcement, connection details, support items, member cross-sections and dimensions, gaskets, openings, manhole steps, size and type of reinforcement and lifting devices which shall be signed and sealed by a Professional Engineer licensed in the Pennsylvania.

C. Indicate design loads, deflections, cambers, bearing requirements, and special conditions.

D. Submit Product Data indicating standard component configurations, design loads, defections, cambers, and bearing requirements.

E. Submit data on proposed use of any admixture under provisions of Section 01300.

F. Submit fabricator's installation instructions under provisions of Section 01300.

G. Submit design data under provisions of Section 01300.

H. Submit design data reports indicating calculations for loadings and stresses of fabricated, designed framing.

I. Submit certificates verifying that the concrete and reinforcement complies with tests and sample requirements of this Specification Section under provisions of Section 01300.

1.05 QUALITY ASSURANCE

A. Testing:

1. Certification from independent testing agency supplied by the manufacturer.

2. Cost of Testing: Borne by Contractor.

B. Codes and Standards:

1. Except as modified by the requirements specified herein and/or the details shown on the Drawings, all work included in this Section shall conform to the applicable provisions of the following codes and standards:

a. ACI 301

b. ACI 318

c. PCI MNL-116

d. PCI MNL-120

e. PCI MNL-123

f. Concrete Reinforcing Steel Institute, "Manual of Standard Practice."

1.06 QUALIFICATIONS

A. Fabricator: Company specializing in manufacturing the Work of this Section with minimum of three years documented experience.

B. Fabricator must be producer/member of the Prestressed Concrete Institute (PCI) and/or participate in its Plant Certification Program.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver Products to site at such times to ensure continuity of installation.

B. Handle precast members in position consistent with their shape and design. Lift and support only from support points.

C. Lifting or Handling Devices: Capable of supporting member in positions anticipated during manufacture, storage transportation, erection.

D. Store and protect members to prevent staining, cracking, chipping, spalling, or other physical damage of concrete.

E. Mark each member with date of production and final position in structure.

PART 2 PRODUCTS

2.01 FABRICATORS

A. Precast concrete manholes, meter pits, etc. shall be as manufactured by Modern Concrete, Rotondo Penn-Cast, Terre Hill Concrete Products or approved equal.

2.02 CONCRETE MATERIALS

A. Water: Potable, clean and free of organic materials, strong acids or alkalis, oils and salt.

B. Portland Cement ASTM-C150, Type I or Type III American manufacture. One (1) brand to be used throughout Project.

C. Sand: (Fine aggregate) shall be clean, sharp, coarse, (minimum fines) hard, natural sand free from salt, loam, clay and other deleterious materials and shall conform to ASTM C33 or C330.

D. Coarse Aggregate: Shall be well graded, washed gravel or crushed stone and shall conform to ASTM C33 for normal weight aggregate.

E. Admixtures: Determined by precast fabricator as appropriate to design requirements and conforming to ASTM C494.

2.03 REINFORCEMENT

A. Reinforcing Steel: Reinforcing bars shall be deformed high strength bars conforming to ASTM A615, Grade 40 or 60.

B. Welded Wire Fabric: Shall conform to ASTM A185.

C. Tensioning Steel Tendons: ASTM A4l6, Grade 250K or 270K, or sufficient strength commensurate with member design. Steel strand tendons shall be encased with an extruded polypropylene sheath and completely filled with corrosion inhibitor. Tendons shall be polystrand as manufactured by Lang Tendons, Inc. or approved equal.

2.04 FORMWORK

A. Forms: Wood, metal, plastic, or other acceptable material that will produce required finish surfaces and is non-reactive with concrete.

B. Maintain formwork to provide completed precast concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified in PCI MNL-116.

2.05 ACCESSORIES

A. Grout: Non-shrink, non-metallic, pre-mixed, non-corrosive, non-staining product containing selected silica sands, portland cement, shrinkage compensating agents, plasticizing and water reducing agents. Minimum yield strength of 10,000 psi at 28 days.

B. High Strength Threaded Fasteners: heavy hexagon structural bolts, heavy bolts, and hardened washers complying with ASTM A325. Exposed units galvanized per ASTM A153;

others painted with rust-inhibitive primer.

C. Anchor Bolts, Nuts, and Washers: Log-Carbon steel bolts, regular hexagon nuts and Carbon steel washers conforming to ASTM A307. Exposed units galvanized per ASTM A153; other painted with rust-inhibitive primer.

D. Anchorage Hardware: Anchors and couplers for tensioning steel tendons shall be sufficient to develop the full strength of the tendons they connect. All anchorage hardware shall be compatible with tensioning steel tendons as recommended by Tendon manufacturer.

E. Supports for Reinforcement: Provide bolsters, chairs, spacers, and other devices for spacing, supporting and fastening reinforcing in accordance with CRSI and ACI recommendations.

F. Gaskets: Precast structure shall be constructed to be watertight through the use of integrally cast rubber or neoprene gaskets. Integrally cast gaskets shall be Dura-Seal III, A-Lok, or equal.

G. Manhole Steps: Grade 60-#3 deformed steel bar coated-polypropylene plastic as manufactured by M.A. Industries, Inc., East Point, Georgia or approved equal.

H. Manhole frames and covers: Heavy duty Model R1648 as manufactured by Neenah Foundry Co. or approved equal.

2.06 FABRICATION

A. Fabrication procedure to conform to PCI MNL-116.

B. Maintain plant records and quality control program during production of precast members. Make records available upon request.

C. Reinforcing steel surface shall be free of rust, mill scale and any coating including ice that could destroy or reduce bond.

D. Reinforcement shall not be bent or straightened in a manner injurious to the material.

E. Reinforcement splices at maximum stress shall not be permitted. Laps and splices shall be of adequate length to transmit stresses. Splices in adjacent bars shall be staggered.

F. Cut wire reinforcement and support at proper elevations by standard accessories.

G. Ensure reinforcing steel, anchors, inserts, plates, angles, and other cast-in items are embedded and located as indicated on Shop Drawings. Locate anchors where they do not affect position of main reinforcement or placing of concrete.

H. Tension reinforcement tendons as required to achieve design load criteria.

I. Cast-in required openings with a dimension larger than 6 inches.

J. Concrete Strength: Minimum ultimate compressive strength of the concrete at age 28 days shall be 5000 psi. Slump shall not exceed 4 inches.

K. For early reuse of forms, concrete may be steam cured after an initial set has taken place. The steam temperature shall not exceed 160 degrees and the temperature shall be raised from normal ambient temperature at a rate that does not exceed 40 degrees per hour. Steam cured units shall not be removed from forms until units have sufficient strength to withstand any structural strain that might be applied during the form stripping process.

2.07 FINISHING

A. Ensure exposed-to-view finished surfaces of precast concrete members are uniform in color and appearance.

B. Cure members under identical conditions to develop required concrete quality, and minimize appearance blemishes such as non-uniformity, staining, or surface cracking.

C. Interior and exterior above grade surfaces - Exposed-to-View Finish: Normal plant finish with fins and protrusions removed, ground edges and ends, and flat face surfaces.

D. Exterior below grade surfaces - Normal plant finish; normal form joint marks, small surface holes caused by air bubbles, minor chips, and spalling at edges or ends, without major discoloration will be tolerated, but no major or unsightly imperfections, honeycomb or structural defects will be permitted. Apply waterproof coatings in accordance with Section07175.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that site conditions are ready to receive Work and field measurements conform with the drawings.

B. Ensure that excavation is free of water and precast units will not be placed on frozen or soft ground.

C. Beginning of installation means installer accepts existing conditions.

3.02 PREPARATION

A. Prepare support equipment for the erection procedure, temporary shoring and bracing, and induced loads during erection.

3.03 INSTALLATION

A. Install precast units according to manufacturer's recommendations and the Drawings without damage to structural capacity, shape, or finish. Replace or repair damaged members.

B. Align and maintain uniform horizontal and vertical joints as erection progresses.

C. Maintain temporary bracing in place until final support is provided. Protect members from staining.

D. Grout open spaces at connections and joints. Provide forms or other acceptable method to

retain grout in place until sufficiently hard to support itself. Pack spaces with stiff grout material and tamp until voids are completely filled. Place grout to finish smooth, plumb and level with adjacent concrete surfaces. Keep grouted joints damp for not less than 24 hours after initial set. Promptly remove grout material from exposed surfaces before it hardens.

E. Do not use power-actuated fasteners for surface attachment of accessory items in precast, prestressed unit unless otherwise accepted by precast manufacturer.

3.04 ERECTION TOLERANCES

A. Erect members level and plumb within allowable tolerances.

B. Conform to PCI MNL-127.

PART 4 CONCRETE STRENGTH

A. Minimum ultimate compressive strength of the concrete at age 28 days shall be 4000 pounds per square inch. Slump shall not exceed 4".

PART 5 EXECUTION

5.01 REINFORCEMENT

A. Before placing, clean rust mill scale or coating, including ice, that would destroy or reduce bond, from surface.

B. Reinforcement shall not be bent or straightened in a manner injurious to the material.

C. Splices at maximum stress not permitted. Laps and splices shall be of adequate length to transmit stresses. Splices in adjacent bars shall be staggered.

D. Wire reinforcement shall be cut and supported at proper elevations by standard accessories.

PART 6 CONCRETE

A. If requested by the Engineer, certificates shall be furnished to the Engineer showing that the concrete and reinforcement complies with tests and samples of applicable specifications.

B. Forms used shall be clean and free from shavings, debris and frost, and thoroughly wetted except in freezing weather, or oiled before placing concrete.

C. Care shall be exercised to prevent honeycombing or segregation of the ingredients of the concrete.

D. All surface defects including tie holes shall be repaired immediately after form removal as per ACI 301-72 Chapter 9.

PART 7 CURING

A. For purposes of early re-use of forms, the concrete may be steam cured after an initial set has taken place. The steam temperature shall not exceed 160 degrees and the temperature shall be raised from normal ambient temperature at a rate that does not exceed 40 degrees per hour.

B. The steam-cured units shall not be removed from the forms until the units are able to withstand sufficient strength and any structural strain that might be applied during the form stripping process.

B. After the stripping for forms, further curing by means of water spraying or membrane curing compound may be used. The compound shall conform to ASTM C309.

PART 8 GASKETS/SEALANTS

A. All pre-cast concrete structures are to be constructed so as to be totally watertight through the use of rubber or neoprene gaskets and approved caulking or non-shrink grout. The exterior of all below grade pre-cast concrete shall be coated in accordance with the paint specification.

PART 9 PRE-CAST CONCRETE MANHOLES AND METER PITS, ETC.

A. The pre-cast concrete manholes, meter pits, etc. shall be as manufactured by Atlantic Pre-cast Corporation, Monarch Pre-cast Concrete Corp., or Terre Hill Concrete Products.

PART 10 SEALS

A. Pre-cast manholes or meter pits shall have integrally cast rubber or neoprene seals at the points where pipe enters and/or exits the pre-cast structure. These gaskets shall meet ASTM C-443 and shall be A-Lok as manufactured by Atlantic Pre-cast or an approved equal.

B. Pre-cast manholes shall have rubber manhole chimney seals (Cretex or approved equal) installed to prevent stormwater inflow and shall consist of the following components:

1. <u>Rubber Sleeve and Extension</u>

   a. The flexible rubber sleeve, extensions and wedge strips shall be extruded from a high grade compound conforming to the applicable requirements of ASTM C-923, with a hardness of 45 +/- 5.

   b. The sleeve shall be double pleated with a minimum unexpanded vertical height of 8 inches, a minimum thickness of 3/16 inches and shall be capable of a vertical expansion when installed of not less than 2 inches. The top and bottom section of the sleeve shall contain an integrally formed expansion band recess and multiple sealing fins.

   c. The extension shall have a minimum thickness of 3/16 inches. The top section of the extension shall be shaped to fit into the bottom band recess of the sleeve under the bottom chimney seal band. The bottom section of the

extension shall contain an integrally formed expansion band recess and multiple sealing fins matching that of the rubber sleeve.

d. Ant splice used to fabricate the sleeve and extension shall be hot vulcanized and have a strength such that the sleeve shall withstand a 180-degree bend with no visible separation.

e. The continuous wedge strip used to adapt the rubber sleeve to sloping surfaces shall have the slope differential needed to provide a vertical band recess surface, be shaped to fit into the band recess, and have an integral band restraint. The length of the wedge strip shall be such that, when its ends are butted together, it will cover the entire inside circumference of that band recess needing slope adjustment.

2. Expansion Bands

a. The expansion bands used to compress the sleeve against the manhole shall be 16-gauge stainless steel conforming to ASTM A-240, Type 304, with a minimum width of 1-¾ inches.

b. The expansion mechanism shall have the capacity to develop the pressures necessary to make a watertight seal and shall have a minimum adjustment range of 2 diameter inches. Studs and nuts used for this mechanism shall be stainless steel conforming to ASTM F-593 and 594, Type 304.

c. Installation shall be in accordance with the manufacturer's instructions.

END OF SECTION

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SECTION 03455

PRECAST CONCRETE MANHOLES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall furnish all materials, labor and equipment and construct manholes consisting of precast sections.

B. Each manhole shall have an invert channel shaped to correspond with the lower half of the pipe. The top of the shelf shall be at the mid-height of the pipe and shall be sloped to drain toward the flowing through channel. Every effort shall be made by the Contractor to construct watertight structures.

1.02 SUBMITTALS

A. Submit to the Engineer shop drawings showing details of construction, reinforcing and joints.

1.03 INSPECTION

A. The quality of all materials, the process of manufacture and the finished manhole sections shall be subject to inspection and approval by the Engineer, or other representatives of the Owner. Such inspection may be made at the place of manufacture, or at the site after delivery, or at both places, and the sections shall be subject to rejection at any time on account of failure to meet any of the Specification requirements, even though sample sections may have been accepted as satisfactory at the place of manufacture. Sections rejected after delivery to the job shall be marked for identification and shall be removed from the job at once. All sections, which have been damaged after delivery will be rejected, and if already installed, shall be acceptably repaired, if permitted, or removed and replaced, entirely at the Contractor's expense.

B. At the time of inspection, the sections will be carefully examined for compliance with the ASTM designation specified below and these Specifications, and with the approved manufacturer's drawings. All sections shall be inspected for general appearance, dimension, "Scratch-strength," blisters, cracks, roughness, soundness, etc. The surface shall be dense and close textured.

C. Imperfections may be repaired, subject to the approval of the Engineer, after demonstration by the manufacturer that strong and permanent repairs result. Repairs shall be carefully inspected before final approval. Cement mortar used for repairs shall have a minimum compressive strength of 6,000 psi at the end of one days and 9,000 psi at the end of 28 days, when tested in 3-inch by 6-inch cylinders stored in the standard manner. Epoxy mortar may be utilized for repairs, subject to the approval of the Engineer.

PART 2 PRODUCTS

2.01 PRECAST CONCRETE SECTIONS

A. Precast concrete manhole barrel and eccentric top sections shall conform to Specifications for Precast Reinforced Concrete Manhole Sections, ASTM C478, with the following additional requirements:

1. The minimum wall thickness for the various size barrel sections shall be as listed below:

   Inside Diameter of Barrel Minimum Wall Thickness:

48 inches	5 inches
60 inches	6 inches
72 inches	7 inches

2. Barrel sections shall have tongue and groove joints. Joints shall have round rubber gaskets set in specially provided indentations. The round rubber "0" Ring gasket shall conform to ASTM C443 Standard Specifications.

3. Type II cement shall be used except as otherwise approved.

4. The date of manufacture and the name of trademark of the manufacturer shall be clearly marked on the inside of each precast section.

5. Sections shall be cured by an approved method and shall not be shipped until at least 5 days after having been fabricated.

6. Top sections shall be eccentric except that precast concrete slabs shall be used where cover over the top of the pipe is less than 4 feet for all manholes.

7. Precast concrete slabs over top section, where required, shall be capable of supporting the overburden plus a live load equivalent to AASHTO H-20 loading.

8. The tops of bases shall be suitably shaped to mate with the precast barrel section.

   a. Manhole rungs shall be made of a steel reinforcing rod completely encased in a copolymer polypropylene and shall be as manufactured by M.A. Industries, Peachtree City, Georgia. Manhole rungs shall be set in precast sections during casting.

9. Gaskets: Pre-cast structure shall be constructed to be watertight with integrally cast rubber or neoprene gaskets. Integrally cast gaskets shall be Dura-Seal III, A-Lok, or equal.

2.02 MANHOLE FRAMES AND COVERS

A. Acceptable Products

Manhole inlet frames and covers shall be equal to those specified below, modified to provide the specified features.

1. All non-watertight manhole frames and covers shall be Neenah Model No. R-1642 with type C patterned lid, self-sealing "O"-ring gasketed with concealed pickholes per NF22642.

2. Terminal manholes shall be equipped with Neenah Model No. R-1642 without gasket.

3. Watertight manholes shall be Neenah Model No. R-1916-F, self-sealing, gasketed and lids bolted with (4) 3" long stainless steel bolts

B. Unless otherwise specified, manhole frames and covers shall be the heavy-duty type designed for H-20 highway loading, shall have a 24-inch clear frame opening and a minimum frame height of 4 1/2 inches and shall be equipped with a continuous-ring type gasket designed to minimize surface water inflow.

C. Cover pattern shall be shall be made accurately to the pattern and dimensions specified and shall be furnished with flat true surfaces. Words "SEWER - DANGER-KEEPOUT" along with BUCKINGHAM TOWNSHIP shall be cast in each cover and shall have concealed or closed pick holes with sufficient dimensions to allow for removal without special equipment. Bearing and wedging surfaces shall be machined to ensure a tight fit and to prevent rocking. Frames shall be provided with four 1-inch diameter holes for anchor bolts. The use of salvaged or scrap materials will not be permitted.

D. Covers shall be provided with a continuous, machined groove on either the underside bearing lip or the outer wedging edge of the cover. A groove on the bearing lip shall be fitted with a glued, continuous, low compression, set gasket; a groove on the outside edge shall be fitted with a neoprene O-ring seal.

E. Locking type, nongasketed frames and covers shall be provided where specified. Locking covers shall have two locking wedges in the frame. Covers shall have two fingers that engage the locking wedges when the cover is positioned in the frame and turned.

2.03 FRAME SEAL

A. The seal shall remain flexible throughout a 25-year design life, allowing repeated vertical movement of the frame of not less than 2 inches and/or repeated horizontal movement of not less than 1/2 inch. The sleeve portion of the seal shall be either double or triple pleated with a minimum unexpanded vertical height of either 8 inches or 10 inches respectively. The sleeve and extension shall have a minimum thickness of 3/16 inches and shall be made from a high quality rubber compound conforming to the applicable requirements of ASTM C-923, with a minimum 1500 psi tensile strength, a maximum 18% compression set and a hardness (durometer) of 48 $\pm$ 5. The bands shall be

integrally formed from 16 gauge stainless steel conforming to ASTM A-240, type 304, with no welded attachments, shall have a minimum adjustment range of 2 diameter inches and a positive locking mechanism. Any screws, bolts or nuts used for this mechanism shall be stainless steel conforming to ASTM F-593 and 594, Type 304.

B. Frame seals shall consist of a flexible internal rubber sleeve, interlocking extensions and stainless steel expansions bands as manufactured by Cretex Specialty Products or approved equal.

C. The Contractor shall measure the manhole to determine the information required on the manufacture's "Sizing and Ordering" Procedure. This information is needed to obtain the proper size of bands, the size and shape of the rubber sleeve and the need for and size of any extensions.

2.04 CEMENTIOUS GROUT

A. Cementitous grout shall be a premixed, non-metallic, high strength grout, which meets the requirements of ASTM C-191 and C-827 as well as CRD C-588 and C621. When mixed to a mortar or "plastic" consistency, it shall have a minimum one-day and 28-day compressive strength of 6,000 psi and 9,000 psi, respectively.

PART 3 EXECUTION

3.01 INSTALLATION

A. Manholes and other precast structures shall be constructed to the dimensions as shown on the Drawings and as specified herein.

B. The base shall be cast-in-place concrete as specified in Section 03300 placed on a thoroughly compacted gravel subbase. The tops of the cast-in-place bases shall be shaped to mate with the precast barrel section, and shall be adjusted in grade so that the top of the dome section is at the approximately correct elevation.

C. Precast bases, conforming to all requirements of ASTM C478 and above listed requirements for precast sections, may be used.

D. Precast concrete structure sections shall be set to be vertical and with sections in true alignment with a 1/4 inch maximum tolerance to be allowed. The outside and inside joint shall be filled with a comparatively dry mortar (one part cement to two parts sand) and finished flush with the adjoining surfaces. Allow joints to set for 24 hours before backfilling. Backfilling shall be done in a careful manner, bringing the fill up evenly on all sides. If leaks appear in the structures, the inside joints shall be caulked with lead wool to the satisfaction of the Engineer. The Contractor shall install the precast sections in a manner that will result in watertight joints.

E. Holes in the concrete pipe sections required for handling or other purposes shall be plugged with a non-shrinking grout or by grout in combination with concrete plugs.

F. Where holes must be cut in the precast sections to accommodate pipes, cutting shall be done prior to setting them in place to prevent any subsequent jarring which may loosen the mortar joints.

G. Tops of all precast manholes shall be brought to proper grade for receiving manhole frames by concrete ring construction. No less than two (2) or more than three (3) courses of rings shall be used for this purpose. All concrete rings shall be laid in full beds of mortar perpendicular to the center of the manhole set with full joints no less than 1/2-inch thickness. Top of the cone section shall be coated with Weld-Crete bonding agent by Larsen Products Corporation or approved equal. Immediately prior to the application of the first bed of mortar.

H. Concrete construction shall be performed by experience and qualified workmen. Concrete ring walls shall be plastered on the outside (not inside) with Portland cement mortar (1/2 inch thick), immediately after coating with the Weld-Crete bonding agent. Do not cover joints where bitumastic joint sealer is used.

I. Concrete ring shall not be constructed during cold weather (when temperature is below 40°F) unless necessary precautions are observed.

END OF SECTION

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SECTION 03500

LEAKAGE TESTS FOR CONCRETE STRUCTURES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. All fluid retaining structures are required to be watertight and shall be tested by the Contractor and witnessed by the Engineer. Structures shall be tested with water as specified.

B. All tests shall be conducted in a manner to minimize as much as possible any interference with the Contractor's work or progress.

C. The Contractor shall notify the Engineer when the work is ready for testing, and tests shall be made as soon thereafter as soon as possible. Personnel for reading meters, gauges, or other measuring devices and all other labor, equipment, air, water, and materials, including meters, gauges, fuel, bulkheads, and accessory equipment, shall be furnished by the Contractor.

1.02 REFERENCES

A. AWWA Journal "A Summary Report on Concrete Water-Holding Structures," AWWA Committee on Concrete Holding Structures

B. ACI Manual of (1989) "Environmental Engineering Practice Concrete Structures," ACI Committee 350 R-89, Part 4, Detroit, MI

1.03 QUALITY ASSURANCE

A. Leakage tests of chambers and tanks shall be made before backfilling by filling the structure with water up to the operating level and observing the water surface level for the following 24 hours. Inspection for leakage will be made of the exterior surface of the structure, especially in the area around construction joints.

B. Each section of water-holding structure, which can be isolated in actual operation, shall be isolated and tested for leakage.

1.04 ALLOWABLE LIMITS

A. Leakage within the allowable limits will be accepted for structures from which there are no visible leaks and in which the surface water drops not more than 1/2 inch during the 24 hr test due to leakage.

B. If leakage exceeds the allowable limits, the structure shall be repaired by locating, removing and replacing the leaking portions of the structure, in accordance with the requirements of Section 03001, or by other means approved by the Engineer. Each structure shall be retested until leakage is within the specified limits.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

3.01 WATER

A. Water for the initial filling of the structures will be supplied by the Owner. The Contractor shall supply all hoses, pumps, labor, and other material to fill the structures. Water for subsequent fillings, if required, shall be at the expense of the Contractor.

3.02 TEST RESULTS

A. The test results shall be reported in writing to the Engineer on the same day that the tests are made.

3.03. ADDITIONAL TESTS

A. Contractor shall perform additional tests as may be required to demonstrate concrete repairs are adequate and conform to the leakage criteria established herein.

END OF SECTION

DIVISION 4

MASONRY

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SECTION 04300

MASONRY

PART 1 GENERAL

1.01 WORK INCLUDED

A. Masonry required for this work as indicated on Drawings or specified herein includes, but is not necessarily limited to, the following:

1. Concrete unit masonry for exterior walls, back-up for cavity walls, and interior partitions, including bond beams where indicated complete with reinforcement and anchorages.

2. Ties, anchors and reinforcement.

3. Mortar for masonry.

4. Formed control joints.

5. Pointing, protection and cleaning.

1.02 QUALITY ASSURANCE

A. Perform masonry work in accordance with requirements of ANSI A41.1 unless indicated otherwise herein.

B. Perform mortar work in accordance with requirements of ASTM C476 unless indicated otherwise herein.

C. Submit, to the Engineer, evidence and test data confirming that concrete block conform to standards stated herein.

D. Qualifications of workmen

1. For cutting and placing of masonry units, only skilled masons experienced with materials and methods specified.

E. Fire rated masonry

1. Wherever a fire resistant classification is shown or scheduled for masonry construction, comply with the requirements for materials and installation established by governing building code.

F. Allowable Tolerances

1. Variation from plumb

a. For lines and surfaces of columns, piers, walls and arises:

In 10 ft.:	1/4"
In any story 20-ft. max.	3/8"
In 40 ft. or more:	1/2"

b. For external corners, expansion joints and other conspicuous lines:

In any story of 20 ft. max.:	1/4"
In 40 ft. or more:	1/2"

2. Variation from the Level or Grades indicated:

a. For exposed lintels, sills, parapets or other conspicuous lines:

In any bay or 20 ft. max.	1/4"
In 40 ft. or more	1/2"

1.03 TESTING

A. Testing of mortar mixes will be performed in accordance with Section 01400.

B. Provide free access to work.

C. Submit proposed mortar mix design to testing firm for approval prior to commencement of work.

D. Tests of mortar mixes will be performed to ensure conformance with requirements stated herein and to ensure mortar will not produce efflorescence.

E. Efflorescence Test for Face Brick

1. Samples of face brick and mortar will be given an accelerated efflorescence test by the Contractor with the test results submitted to the Architect for approval prior to the starting of masonry work.

The mortar proposed for use shall be cast into a brick size using all the ingredients and proportions specified. Samples shall be cured for 14 days. After curing, the mortar (2 samples) and brick (3 samples) shall be placed on end in clean shallow metal pans containing distilled water to a depth of water maintained. If, at the end of the test period, the samples of brick or mortar show efflorescence, the materials represented shall be rejected and new materials shall be retested until no efflorescence appears. Testing shall be done by an independent laboratory in accordance with Section 01400.

F. If mortar mixes do not conform to requirements stated herein, re-establish and re-submit for further testing. Contractor shall pay costs for required re-testing.

1.04 REFERENCE STANDARDS

A. ASTM C150 - Portland Cement

B. ASTM C91 - Masonry Cement

C. ASTM C216 - Facing Brick

D. ASTM C62 - Building Brick

E. ASTM C207 - Hydrated Lime for Masonry Purposes

F. ASTM C144 - Aggregate for Masonry Mortar

G. ASTM C90 - Hollow Lead Bearing Concrete Masonry Units

H. ASTM C145 - Solid Load Bearing Concrete Masonry Units

I. ASTM C129 - Hollow Non-Load Bearing Concrete Masonry Units

J. ASTM C55 - Concrete Building Brick

K. ASTM C476 - Mortar and Grout for Unit Masonry

L. ANSI A41.1 - Building Code Requirements for Masonry

1.05 SUBMITTALS

A. Submit manufacturer's recommendations and product data to Engineer for approval.

B. Submit shop drawings with:

1. Details of all regular and special shapes, including sills and coping; include details of sill flashing installation.

2. Drawings showing intersection of masonry walls at other than 90 deg. angle.

C. Certification

1. Prior to delivery of concrete block masonry to the job site, deliver to the Engineer a letter from the manufacturers certifying that all such units delivered to the job site are in strict conformance with the provisions of this Section of these specifications.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Maintain materials and surrounding air temperature to minimum 40 ºF. prior to, during and 48 hours after completion of masonry work.

B. Comply with governing codes and with the "Construction and Protection Recommendations for all Weather Masonry Construction" of the Technical Notes on Brick and Tile Construction by the Brick Institute of America (BIA).

C. Cold Weather Requirements

1. General

a. Protect masonry units, cementitious materials and sand so that they are not contaminated by rain, snow or ground water. Loose board covering will not be permitted.

b. Cover tops of masonry at all times when work is not in progress. Cover shall extend a minimum of 2 ft down the masonry, and shall be securely held in place.

c. Units with higher initial rates of absorption up to 40 g/min/30 $in.^2$ may be used to resist mortar freezing. However, units with suctions in excess of 30 g/min/30 $in.^2$ shall be sprinkled, but not saturated, with heated water just prior to laying. Water temperature shall be above 70 ºF when units are above 32 ºF. If units are 32 ºF or below, water temperature shall be above 120 ºF.

d. Heat sand and water used in mortar and grout mixtures to a minimum temperature of 70 ºF and a maximum temperature of 160 ºF. Keep mortar temperature less than 120 ºF to avoid flash set.

e. Maintain temperature of masonry units above 20 ºF when laid.

f. Place grout at a minimum temperature of 40 ºF and a maximum temperature of 120 ºF. Maintain masonry receiving grout above 40 ºF. Maintain grouted masonry above 32 ºF for 48 hours following placement of grout.

2. Masonry Construction in Cold Weather

Temperature (see note)	Construction Requirements	Protection Requirements
100 ºF to 40 ºF	Normal procedures.	Cover walls with plastic or canvas at end of work day to prevent water from entering masonry.
40 ºF to 32 ºF	Heat mixing water or sand to produce motor between 40	Completely cover newly constructed masonry with

Temperature (see note)	Construction Requirements	Protection Requirements
	ºF to 120 ºF	weather resistant membrane for 48 hr after construction.
32 ºF to 25 ºF	Heat mixing water or sand to produce motor between 40 ºF and 120 ºF. Heat grout materials so grout is placed at temperatures between 40 ºF and 120 ºF. Maintain motor and grout above freezing until used in masonry.	Completely cover newly constructed masonry with weather resistant membrane for 48 hr after construction.
25 ºF to 20 ºF	Heat mixing water or sand to produce motor between 40 ºF and 120 ºF. Heat grout materials so grout is placed at temperatures between 40 ºF and 120 ºF. Maintain motor and grout above freezing. Heat masonry units to 40 ºF if grouting. Use heat source on both sides of walls under construction.	Completely cover newly constructed masonry with insulating blankets or equal protection for 48 hr after construction. Install wind breaks when wind velocity exceeds 15 mph.
20 ºF and below	Heat mixing water or sand to produce motor between 40 ºF and 120 ºF. Heat grout materials so grout is placed at temperatures between 40 ºF and 120 ºF. Maintain motor and grout above freezing. Heat masonry units to 40 ºF if grouting. Use heat source on both sides of walls under construction. Provide enclosure and heat to maintain temperatures above 32 ºF within enclosure	Provide enclosure and heat to maintain temperatures above 32 F within the enclosure for 48 hr after construction. Heat may be provided by electric heating blankets, infrared heat lamps or other approved methods

Note: Construction requirements, while work is in progress, are based on ambient temperatures. Protection requirements, after masonry is placed, are based on mean daily temperatures.

D. Hot Weather Requirements

1. General

   a. Maintain temperature of mortar and grout between 70 ºF and 120 ºF.

   b. Cold water may be used when mixing mortar and grout. Ice used to lower the mix water temperature must be completely melted before adding the water to the other ingredients.

   c. Masonry units with high suctions IRA over 30 g/min/30 $in.^2$ should be properly wetted prior to use.

   d. Mortar with high water retention is desirable.

   e. Partially completed walls shall be fog sprayed at the end of the workday to control moisture evaporation.

2. Masonry Construction in Hot Weather

Temperature (see note)	Construction Requirements	Protection Requirements
Above 100 ºF or 90 ºF with 8 mph wind	Maintain motor and grout at a temperature between 70 ºF and 120 ºF. Limit spread of motor to 4 ft. Place units within 1 minute of spreading motor	Partially or newly completed walls shall be fog sprayed and/or covered with plastic or canvas to control moisture evaporation.
100 ºF to 40 ºF	Normal procedures.	Cover walls with plastic or canvas at end of workday to prevent water from entering masonry.

Note: Construction requirements, while work is in progress, are based on ambient temperatures. Protection requirements, after masonry is placed, are based on mean daily temperatures.

E. In exposed work do not use masonry units with chips, cracks, voids, discoloration's or other defects, which might be visible or cause staining in the finished work.

F. Protect partially completed masonry against weather, when work is not in progress, by covering top of walls with strong waterproof, non-staining membrane. Extend membrane at least 2' down both sides of walls and hold securely in place.

G. Do not use frozen materials or materials mixed or coated with ice or frost. For masonry which is to be wetted, comply with BIA recommendations.

H. Do not build on frozen work. Remove and replace masonry work damaged by frost or freezing.

1.07 PROTECTION

A. Maintain protective boards at exposed external corners, which may be damaged by construction activities. Provide such protection without damaging completed work.

B. Keep expansion joint voids clear of mortar.

C. Provide temporary bracing during masonry erection. Maintain in place until building structure provides permanent bracing.

D. Use all means necessary to protect materials before, during and after installation and to protect the installed work and materials of all other trades.

E. In the event of damage, immediately make all repairs and replacements necessary to the approval of the ENGINEER and at no additional costs.

PART 2 PRODUCTS

2.01 MASONRY

A. On all exterior exposed walls provide Decorative Concrete Masonry Units as manufactured by New Holland Concrete (or approved equal) and in compliance with ASTM C90 specifications as follows:

1. Unit Compressive Strength: 1900-psi net area unit compressive strength average of three units none to be less than 1700 psi.

2. Weight Classification: Normal Weight using aggregates complying with ASTM C33.

3. Provide Type 1 Moisture-controlled units.

4. Size: Manufacturer's standard units with nominal face size of 8" high x 16" long (7-5/8" actual) x thickness indicated, complete with corners, bases, bond beams, lintels and fillers to match and complement block units; standard weight. External corners bull-nosed.

5. Finish: exposed faces of the following general description selecting from the manufacturer's standard colors and textures.

   a. Normal Weight Aggregate, split face

6. Integral Water Repellent: Provide units manufactured with a two part liquid polymeric water repellent admixture system for concrete masonry units and for mortar which achieve an "E" (Excellent) rating by the ASSTM E 514, "Standard Test Method for Water Penetration and Leakage Through Masonry."

   a. Product: Subject to compliance with requirements, provide units made with Rhoemix Rheopel by Master Builders Technologies, Inc.

7. Color: Owner to Select.

B. All interior walls provide Concrete Masonry Units as manufactured by New Holland Concrete (or approved equal) and in compliance with ASTM C90 specifications as follows:

1. Concrete Blocks: ASTM C90 Hollow Core load bearing, C145 Solid Core load bearing and C129 Hollow core Non-Load Bearing, Grade N, Type I, 8" x 16" face size, complete with corners, bases, bond beams, lintels and fillers to match and complement block units; standard weight. External corners bull-nosed.

2.02 MORTAR MATERIALS

A. Portland Cement: ASTM C150 Type I.

B. Aggregates: Standard masonry type, conforming to ASTM C144 and free of frozen and foreign matter.

C. Hydrated Lime: ASTM C207 Type S.

D. Quicklime: Non-hydraulic Type ASTM C5.

E. Premix Mortar: Commercially prepared type, ASTM C387 mortar Type S.

F. Water: Clean and free from injurious amounts of oil, alkali, organic matter or other deleterious materials.

G. Masonry Cement: The use of masonry cement is not permitted.

2.03 REINFORCEMENT AND ANCHORAGES

A. Reinforcing Steel for Bond Beams and Lintels: ASTM A615, Grade 60.

B. Reinforcing Wire for Horizontal Reinforcing: ASTM A82 deformed steel with ASTM A116 Class 3 galvanized coating.

C. Horizontal Wall Reinforcing: Joint reinforcement for single wythe walls shall be Lox All® Truss-Mesh as manufactured by HOHMANN & BARNARD, INC., Hauppauge, NY or approved equal. Reinforcement shall be fabricated from cold-drawn steel wire conforming to ASTM A82 with smooth 9 gauge cross rods butt welded not more than 16" o.c. to deformed 3/16” side rods. Finish shall conform to hot dip galvanized. Factory prefabricated corners and tees shall be used at all corners and intersecting walls and shall be of the same gauge, finish and design as the continuous joint reinforcement.

D. Column and Other Anchors: See structural drawings.

2.04 GROUT

A. Grout shall conform to ASTM C476 – Mortar and Grout for Reinforced Masonry

B. Aggregates shall conform to ASTM C404 – Aggregates for Masonry Grout

C. Grout shall have a minimum 28-day compressive strength of 2,500 psi with the following proportions:

1. Fine Grout

Portland Cement	1
Lime	0 to 1/10
Fine aggregate	2-1/2 to 3

2. Coarse Grout

Portland Cement	1
Lime	0 to 1/10
Fine aggregate	2-1/2 to 3
Coarse aggregate	1 to 2

D. Fine grout shall be used in spaces with least horizontal dimension greater than ¾ inches and less than 2-1/2 inches. Coarse grout shall be used in all spaces with dimensions 2-1/2 inches or greater.

2.05 ACCESSORIES

A. Control Joints: Performed rubber, neoprene or polyvinylchloride of sizes and profiles as shown; Rapid control joint as manufactured by Dur-O-Wal Corporation or equal.

B. Joint Filler: Closed cell polyvinylchloride, polyethylene or polyurethane oversized 50% self-expanding.

2.06 MORTAR MIX

A. Provide minimum 1800 psi ASTM C270, Type S, mortar. Masonry cement is not to be used.

B. Thoroughly mix mortar ingredients in quantities needed for immediate use.

C. Do not use anti-freeze compounds to lower the freezing point of mortar or any other additives.

D. Use mortar within two (2) hours of mixing at temperatures over 78 degrees F., and two and one half (2-1/2) hours at temperatures under 50 degrees F.

E. If necessary, retemper mortar within two (2) hours of mixing to replace water lost by evaporation. Do not retemper mortar after two (2) hours of mixing.

PART 3 EXECUTION

3.01 PREPARATION

A. Supply metal anchors for placement under other Sections. Provide sufficient quantity and direct their correct placement.

B. Ensure items built-in by other trades for this work are properly located and sized.

C. Establish lines, levels and coursing. Protect from disturbances.

D. Brace masonry for wet grout pressure.

3.02 WORKMANSHIP AND INSTALLATION

A. Place masonry in accordance with lines and levels indicated on drawings.

B. Fully bond external and internal corners and intersections.

C. Isolate masonry partitions from vertical structural framing members with a control joint with mortar raked back 1/4 inch regardless of joint treatment.

D. Buttering corners of joints, deep or excessive furrowing of mortar joint is not permitted.

E. Do not shift or tap masonry after mortar has taken initial set. Where adjustment must be made, remove mortar and replace.

F. Perform job site cutting of masonry with proper power tools to provide straight and true, unchipped edges.

G. Where non-bearing masonry partitions extend to underside of floor, roof deck or structural system, stop masonry short 3/8 to 1/2 inch to allow for live load deflection. Fill gap with joint filler. Provide structural anchorage or retention in accordance with ANSI A41.1.

H. Ensure masonry courses are of uniform height. Make vertical and horizontal joints equal and of uniform thickness. Lay in full bed of mortar, properly jointed with other work.

I. Remove excess mortar and projections. Take care to prevent breaking masonry corners. Form concave mortar joints for brick and block.

J. Lay concrete block in running bond. Course 1 block unit and 1 mortar joint to equal 8 inches. Do not wet block when laying.

K. Strike mortar joints of concrete block flush, where resilient floor base is scheduled.

L. Clean masonry after mortar is thoroughly set and cured using bucket and brush and cleaning method.

M. Where joints occur in grout, they shall be made 2 inches below the block joint so that a key is provided.

N. Grout full masonry walls from top of floor to underside of all lintels at openings for a distance of 16 inches adjacent to each side of opening, unless shown otherwise on the drawings.

3.03 TOLERANCES

A. Maximum variation from masonry unit to adjacent masonry unit is 1/16 inch.

B. Maximum variation from vertical and horizontal building lines is 1/4 inch in 10 feet.

C. Maximum variation from cross sectional thickness of walls is plus or minus 1/4 inch.

D. Maintain flush face on exposed masonry surfaces.

3.04 REINFORCEMENT AND ANCHORAGES

A. Place masonry reinforcing and anchorage's for concrete unit masonry as follows:

1. Provide walls with horizontal masonry reinforcing in every second CMU mortar joint.

2. Place horizontal masonry reinforcing in first and second joints above and below openings. Place continuous in first and second joint below top of walls.

3. Fully reinforce corners and intersections.

4. Lap masonry reinforcing splices minimum 6 inches.

5. Ensure that anchorage's embedded in concrete or attached to structural steel members for concrete block are properly placed. Embed free end of anchorages in every second concrete block joint.

3.05 LINTELS

A. Provide reinforced concrete block lintels over openings where steel lintels are not scheduled.

3.06 BOND BEAMS

A. Reinforce as shown.

B. Place and consolidate concrete without disturbing reinforcing.

3.07 CONTROL JOINTS

A. Install concrete joints where shown. Control joints shall be located in the building exterior walls. At a minimum control joints be spaced less then 25' on center.

B. Do not continue masonry reinforcing across control joints.

3.08 BUILT-IN WORK

A. As work progresses, build-in hollow metal frames, window frames, steel angle lintels, nailing strips, anchor bolts, plates and other items supplied by other trades.

B. Build-in items plumb and true.

C. Bed anchors of hollow metal frames in mortar joints. Fill frame voids solid with mortar. Fill masonry cores with grout minimum 12 inches from framed openings.

D. Do not build-in organic materials, which will be subjected to rot or deterioration.

3.09 CUTTING AND FITTING

A. Cut and fit masonry for chases, pipes, conduit, sleeves, grounds and other work. Cooperate fully with other sections of work to ensure correct size, shape and location.

B. Obtain Engineer's review prior to cutting or fitting any area which is not indicated on drawings or which may impair appearance or strength of masonry work.

C. Cut and rework existing masonry as shown for installation of new work. Tooth new work into existing.

3.10 PARGING

A. Parge concrete block walls where shown in 2 uniform coats. Maintain total thickness shown.

B. Dampen masonry walls prior to application.

C. Scarify each coat to allow full bonding.

D. Trowel finished surface smooth and flat.

END OF SECTION

DIVISION 5

METALS

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SECTION 05120

STRUCTURAL STEEL

PART 1 GENERAL

1.01 WORK INCLUDED

A. This section of the work includes all labor, equipment and materials for the following structural steel as shown on the drawings and/or as specified.

1. Structural steel framing, support and bracing members.

2. Plates, angles, washers, bolts, shims for connections.

3. Welding for fabrication and connectors.

4. Erection.

5. Grouting of base plates and bearing plates.

1.02 QUALITY ASSURANCE

A. Codes and Standards: Comply with the provisions of the following codes, specifications and standards:

1. AISC "Code of Standard Practice for Steel Buildings and Bridges".

1.03 REFERENCES

A. ANSI/AWS A2.4 - Standard Symbols for Welding, Brazing and Nondestructive Examination.

B. ANSI/AWS D1.1 - Structural Welding Code, Steel.

C. ANSI/NAAMM MBG 531 - Metal Bar Grating Manual.

D. ANSI/NAAMM MBG 532 - Heavy Duty Metal Bar Grating Manual.

E. ASTM A36 - Structural Steel.

F. ASTM A123 - Zinc (Hot-Dip Galvanized) Coating on Iron and Steel Products.

G. Steel Structures Painting Council (SSPC) - Steel Structures Painting Manual.

1.04 SUBMITTALS

A. Submit shop and fabrication drawings in accordance with Section 01300 and with AISC Specifications.

B. Clearly indicate profiles, sizes, spacing and locations of structural members, connections, attachments, anchorages, framed openings, size and type of fasteners, cambors and loads.

C. Indicate welded connections using standard AWS welding symbols. Clearly indicate net weld lengths.

D. Submit anchor bolt plan in advance of other submissions.

E. Mill reports are not required. Certification is required upon request.

PART 2 PRODUCTS

2.01 MATERIALS

A. Rolled steel shapes, bars and plats: ASTM A-36.

B. High strength bolts: ASTM A-325N load

C. Bolts, washers and nuts: ASTM A-307; galvanized to ASTM A153 for galvanized components.

D. Primer paint: Fed. Spec. TT-P-636 or SSPC - Paint 13.

E. Plates: ASTM A283

F. Galvanized items to minimum 2.01 oz/sq. ft. zinc coating in accordance with ASTM A386.

2.02 FINISHES

A. All metal for monorails and monorail supports painted epoxy.

B. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

C. Paint according to Section 09900.

D. Grout for base plates and bearing plates: Non-shrink, non-staining high early strength grout. "Five Star Grout" as manufactured by U.S. Grout Corporation or equal.

PART 3 EXECUTION

3.01 FABRICATION

A. Structural steel shall be fabricated and assembled in the shop to the greatest extent possible. Parts not completely assembled in the shop shall be secured with bolts. All work shall be equal to the best modern shop practices. Connections shall conform to the requirements of AISC specifications. Shop connections shall be welded or bolted. Connections to columns shall be bolted with high strength bolts or welded.

B. Connections shall be designed in accordance with the reactions shown on the drawings or the reaction for a uniformly loaded beam as tabulated in the AISC Manual of Steel Construction, whichever is greater.

C. Substitution of sections or modification of detail or both shall not be made without the approval of the Engineer. Such changes, when approved, shall be made with no additional cost to Owner.

3.02 WELDED CONSTRUCTION

A. Comply with AWS Code for procedures, appearance and quality of welds, and methods used in correcting welding work.

B. Assemble and weld built-up sections by methods that will produce true alignment of axes without warp.

3.03 HOLES FOR OTHER WORK

A. Provide holes required for securing other work to structural steel framing and for the passage of other work through steel framing members, as shown on the contract drawings.

B. Provide staggered holes for bolting wood blocking to steel 9/16" diameter holes 3'-0" o.c. when wood blocking is shown adjacent to structural steel.

3.04 MISCELLANEOUS ITEMS

A. Furnish base plates, leveling plates, anchor bolts and washers for all items specified in this section.

3.05 SHOP PAINTING

A. Shop paint all structural steel work, except those members or portions of members to be embedded in concrete or mortar. Do not paint contact surfaces, which are to be welded or high-strength bolted with friction type connections. Do not paint top surfaces of beam flanges where composite construction is indicated or where metal deck must be welded to flange.

B. Clean all steel work to be painted. Remove loose rust, mill scale and spatter, slag or flux deposits. Clean steel in accordance with SSPC (Steel Structures Painting Council) as follows: SP-3 "Power Tool Cleaning".

C. Immediately after surface preparation, apply structural steel primer paint in accordance with the manufacturer's instructions and at a rate to provide a uniform, dry film thickness of 2.0 mils. Use painting methods which will result in full coverage of joints, corners, edges and all exposed surfaces.

D. All material shall be stored above ground. Material shall be kept free of dirt, grease and other foreign matter and shall be protected from corrosion.

E. Do not store materials on the structure in a manner that might cause distortion or damage to the members of the supporting structures. Repair or replace damaged materials or structures as directed.

3.07 ERECTION

A. Comply with the AISC Specifications and Code of Standard Practice and with specified requirements. Erection shall be in accordance with the applicable sections of the AISC Specification. As erection progresses the work shall be securely fastened and guyed to take care of all load, wind and erection stresses. Damage to the structure because of poor workmanship, inadequate guying, etc., and personal injury because of same shall be the responsibility of the Contractor. Structural damage shall be repaired and/or replaced as directed at no additional cost to Owner.

B. Provide temporary planking, working platforms, and railings as required and as necessary to effectively complete the work and to provide protection for workmen.

C. Anchor Bolts:

1. Furnish anchor bolts to be set under the work of other Sections.

2. Establishment of bearing of leveling plates to the correct elevations and centers shall be part of the work of this Section.

3. Furnish templates, adjustable setting sleeves and other devices as necessary for presetting bolts and other anchors to accurate locations.

D. Setting Bases and Bearing Plates:

1. Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean the bottom surface of base and bearing plates. Set bearing plates for structural members on shims. Tighten the anchor bolts after the supported members have been positioned and plumbed. Do not remove shims, but if protruding, cut off flush with the edge of the base or bearing plate.

2. Mix no-shrink grout in strict accordance with the manufacturer's instructions. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain. Finish exposed surfaces and allow to cure in strict compliance with the manufacturer's instructions, or as otherwise required.

E. Erection of Steel:

1. Drift pins may be used only to align the several parts in such a manner as to not distort or damage the metal. The use of a torch will not be permitted for correcting fabrication errors, unless approved in writing. High strength bolts shall be installed in accordance with the AISC Specification for Structural Joints Using ASTM A325 Bolts with Load Indicating feature. Standard bolt connections shall have the threads burred after final bolting to prevent nut from working loose. 1/16-inch

shims are to be furnished columns. Field welding shall be performed by certified welders qualified by test using procedures covered in the American Welding Society Standard.

2. Level and plumb individual members of the structure within specified AISC tolerances to lines and levels indicated.

3. Comply with AISC specifications for bearing, adequacy of temporary connections, alignments and the removal of paint on surfaces adjacent to field welds.

4. No cutting of holes, slot or other openings in the field, by other trades will be permitted without approval by Engineer.

3.08 FIELD PAINTING

A. Abraded spots, bolts and field welds shall be touched up with an approved metal protective paint equivalent to and compatible with shop coat.

END OF SECTION

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SECTION 05490

METAL FABRICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Shop fabricated ferrous metal items, galvanized and prime painted.

1.02 REFERENCES

A. ASTM A36 - Structural Steel.

B. ASTM A53 - Hot-Dipped, Zinc-coated Welded and Seamless Steel Pipe.

C. ASTM A123 - Zinc (Hot-Galvanized) Coatings on Products Fabricated From Rolled, Pressed and Forged Steel Shapes, Plates, Bars, and Strip.

D. ASTM A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

E. ASTM A283 - Carbon Steel Plates, Shapes, and Bars.

F. ASTM A307 - Carbon Steel Externally Threaded Standard Fasteners.

G. ASTM A325 - High Strength Bolts for Structural Steel Joints.

H. ASTM A386 - Zinc-Coating (Hot-Dip) on Assembled Steel Products.

I. ASTM A500 - Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Round and Shapes.

J. ASTM A501 - Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.

K. AWS A2.0 - Standard Welding Symbols.

L. AWS D1.1 - Structural Welding Code.

M. SSPC - Steel Structures Painting Council.

1.03 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.

C. Indicate welded connections using standard AWS A2.0 welding symbols. Indicate net weld lengths.

1.04 QUALIFICATIONS

A. Prepare Shop Drawings under direct supervision of a Professional Engineer experienced in design of this work and licensed in the State of Pennsylvania.

B. Welders' Certificates: Submit under provisions of Section 01300, certifying welders employed on the Work, verifying AWS qualification within the previous 12 months.

1.05 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on drawings, shop drawings and as instructed by the manufacturer.

PART 2 PRODUCTS

2.01 MATERIALS

A. Steel Sections: ASTM A36.

B. Plates: ASTM A283.

C. Pipe: ASTM A53, Grade B Schedule 40.

D. Bolts, Nuts, and Washers: ASTM A325 galvanized to ASTM A153 for galvanized components.

E. Welding Materials: AWS D1.1; type required for materials being welded.

F. Shop and Touch-Up Primer: SSPC 15, Type 1, red oxide.

G. Touch-Up Primer for Galvanized Surfaces: Zinc rich type.

2.02 FABRICATION

A. Fit and shop assemble in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Continuously seal joined members by continuous welds.

D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

F. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.03 FINISHES

A. All metal fabrications shall be galvanized unless otherwise specified on the drawings.

B. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

C. Do not prime surfaces in direct contact with concrete or where field welding is required.

D. Prime paint items with one coat.

E. Galvanized items to minimum 2.01 oz/sq. ft zinc coating in accordance with ASTM A386.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

B. Beginning of installation means erector accepts existing conditions.

3.02 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Supply items required to be cast into concrete or embedded in masonry with setting templates, to appropriate sections.

3.03 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Field weld components indicated on Drawings and/or shop drawings.

D. Perform field welding in accordance with AWS D1.1.

E. Obtain Engineer approval prior to site cutting or making adjustments not scheduled.

F. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

3.04 ERECTION TOLERANCES

A. Maximum Offset From True Alignment: ¼ inch.

END OF SECTION

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SECTION 05520

ALUMINUM HANDRAILS AND RAILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Mechanical aluminum handrails, balusters, and fittings.

1.02 REFERENCE STANDARDS

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ALUMINUM ASSOCIATION (AA)

AA Design Manual	(2000) AA Design Manual: Specifications and Guidelines for Aluminum Structures
AA DAF-45	(1997) Designation System for Aluminum Finishes

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 193	(2000) (1996b) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM B 211	(1995a) Aluminum and Aluminum-Alloy Bar, Rod, and Wire
ASTM B 221	(1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B 241	(1996) Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube

OCCUPATIONAL SAFETY AND HEALTH ACT (OSHA)

OSHA: 1910.23	Guarding Floor and Wall Openings and Holes

1.03 DESIGN REQUIREMENTS

A. All railings shall meet the OSHA requirements including but not limited to:

1. Every stairway floor opening shall be guarded by a railing on all exposed sides except at entrance to stairway.

2. Every wall opening, open sided floor, platform or runway from which there is a drop of more than four feet shall be guarded by a rail or equivalent.

3. Railing shall be provided with a toe board wherever, beneath the open sides, a person can pass, there is moving machinery, or there is equipment with which falling material could create a hazard.

4. Regardless of height, open sided floors, walkways, platforms or runways above dangerous equipment shall be guarded with standard railing and toeboards.

5. Every flight of stairs with four or more risers shall be equipped with standard railings or standard handrails.

   - Stairways less than 44" wide, both sides enclosed, at least one handrail, preferably on right side descending.
   - Stairways less than 44" wide having one open side, at least one railing on open side.
   - Stairways less than 44" wide having both sides open, one stair railing on both sides.
   - Stairways more than 44" wide, but less than 88" wide one handrail on each enclosed side and one stair railing on each open side.
   - Stairways 88" or more wide, one handrail on each enclosed side, one stair railing on each open side and one intermediate stair railing located approximately midway of the width.

6. A "Standard Railing" shall consist of a top rail, intermediate rail, and posts and shall have a minimum vertical height of 42" nominal from the upper surface of the top rail to floor. The top rail shall be smooth surfaced throughout its length. The intermediate rail shall be about halfway between the top rail and the floor. The ends of the rails shall not overhang the terminal posts to the extent of causing a projection hazard.

7. A "Stair Railing" shall be of similar construction to standard railing, but the vertical height shall be not more than 34" nor less than 30" from the upper surface of the top rail to the surface of the tread in line with the face of the riser at the forward edge of the tread.

8. Anchoring of posts and framing of members for railings of all types shall be of such construction that the completed structure shall be capable of withstanding a load of at least 200 pounds applied at any direction at any point on the top rail.

9. A "Standard Toeboard" shall be 4" nominal in vertical height from its top edge to the level of the floor. The toeboard shall be securely fastened in placed with not more than l/4" clearance above floor level. Where material is piled to such a height that a standard toeboard does not provide protection, paneling from floor to intermediate rail, or to top rail shall be provided.

10. Aluminum in contact with concrete shall be coated.

1.04 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.

C. The Manufacturer of the prefabricated handrail system shall furnish complete shop drawings in enough detail to show all types of handrail and mounting attachments utilized on the project. The submittal package shall include design calculations showing that the material meets or exceeds the allowable working stress under the applied loading conditions. Test reports shall be used to complement the design calculations.

1.05 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on Drawings and shop drawings.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. The following manufactures are acceptable for the prefabricated handrail system and appurtenances:

1. Alumaguard Corp, of Denver, Colorado, 80223, (303)-935-7245
2. Series 500 Railing System, J.G. Braun Company, of Morton Grove, IL (847) 633-9300
3. Tabco 2500 Railing Systems, Tuttle Aluminum and Bronze Company of Fishers, Indiana, (317)-842-2420
4. Series 500 Railing System, Superior Aluminum Corp, of Russia, Ohio (937) 439-4800
5. Couger Systems Inc, of Aurora, Colorado, 80010, (303)-343-8100
6. Or approved equal

2.02 ALUMINUM RAILING SYSTEM

A. Construction: All pipe for handrail shall be 6063-T6 or superior grade aluminum alloy. All posts and rails shall be manufactured from 1-1/2" nominal I.P.S. pipe. Reinforcing inserts shall be supplied to meet the structural requirements. All fittings shall be machined from one-piece aluminum extrusion.

B. Toe board: ¼ x 4” aluminum with not more than 1/4 “ clearance above floor level as prescribed by OSHA.

C. Splice and reinforcing sleeves shall be aluminum. Brackets, end caps, and other fittings shall be machined from a one piece extrusion to final shape.

D. Mounting: Brackets and flanges mounted on concrete.

E. Exposed Fasteners: All fasteners shall be 304 or 305 stainless steel. All anchor bolts shall be stainless steel 300 series.

F. Finish: All handrail pipes shall be anodized (215 R1) and machined components shall be anodized (204 R1).

G. Dissimilar Materials: All handrail components shall be protected from electrolysis by either zinc chromate (P759-66), bitumastic paint or neoprene gaskets.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

B. Beginning of installation means erector accepts existing conditions.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install components plumb and level, accurately fitted, free from distortion or defects.

C. All pipe cuts shall be square and accurate for minimum joint-gap. Cuts shall be clean and free of chamfer, from deburring, nicks and burrs. Holes shall be drilled the proper size for a tight flush fit of rivets and screws.

D. Adjust railings prior to anchoring to ensure matching alignment at butting joints. Space posts not more than 8' on centers, unless otherwise shown.

E. Railing shall be secured to supporting structures as follows:

1. For removable handrail, post shall be secured by aluminum socket as shown on the drawings.

2. For stationary handrail, mount with socket and expansion bolt system.

F. For continuous spans in excess of 40 feet, expansion joints shall be provided. To make an expansion joint, one end of the spliced joint shall not have structural adhesive applied so that it is free to move in or out of the pipe. If a joint is provided every 30 feet, the width of the gap should allow 1/8" expansion for each 40 degree F of expected temperature rise. All pipe-railing splices should be made no more than 12" from the nearest post.

END OF SECTION

SECTION 05530

ALUMINUM GRATING AND FLOOR PLATES

PART 1 GENERAL

1.01 WORK INCLUDED

A. Metal gratings.

B. Formed openings.

1.02 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01300.

B. Provide details of grates, plates, supports, span and deflection table, openings, and perimeter construction details and tolerances.

1.03 PERFORMANCE REQUIREMENTS

A. Floor grating shall be designed for a maximum deflection of ¼-inch when supporting a 100 psf uniform load.

B. Plate thickness shall be determined based on a maximum deflection of 150 of the short side, or a stress of 15,000 psi under a 100 psf uniform load. The larger plate thickness shall govern.

1.04 DISSIMILAR MATERIALS

A. Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry, wet or pressure-treated wood, or absorptive materials subject to wetting, the surfaces shall be protected with a coat of bituminous paint or asphalt varnish.

PART 2 PRODUCTS

2.01 ALUMINUM FLOOR GRATING

A. All grating, unless otherwise specified, shall be aluminum plank grating (extruded 6063 aluminum with integral I-beams and a fluted, skid resistant walking surface).

B. Acceptable manufacturers include the following:

1. IKG, Industries (800) 747-8982
2. Ohio Gratings, Inc. (800) 494-4459
3. Philadelphia Grating (215) 427-1700
4. Approved equal

C. All edges of the grating and all openings in the grating for pipe and miscellaneous equipment shall be banded by welding on minimum 1/8-inch thick bars. The band shall have less depth than the bearing bars, to permit drainage.

D Individual sections shall be of a size to permit ease of handling with a maximum length not in excess of 8 feet

E Where possible, provide a 6-inch wide section of grating over each stop gate and over each valve-operating nut.

F. All aluminum grating support angles shall be aluminum. Support angles shall be provided at the bearing ends of all grating. This includes locations such as wall openings and corners.

G. Provide 4-inch by ¼-inch toe boards anchored to edge of grating at all slide gates in grated areas.

2.02 ALUMINUM CHECKERED FLOOR PLATE

A. Aluminum checkered plate shall be manufactured from aluminum alloy 6061-T6

B. Support angles for floor plate shall be aluminum

C. Provide hand hole in each plate

D. Plate size shall be limited to a maximum weight of 40 pounds

2.0 FASTENERS

A. Fasteners: Stainless steel.

2.04 FINISHES

A. Aluminum: Mill finish.

PART 3 EXECUTION

3.01 INSPECTION

A. Verify that opening sizes and dimensional variations are acceptable to suit grating tolerances.

B. Verify that supports and anchors are correctly positioned.

C. Beginning of installation means acceptance of existing conditions.

3.02 INSTALLATION

A. Install grates in accordance with manufacturer's instructions.

B. Mechanically cut finished surfaces. Do not use flame-cutting tools.

END OF SECTION

DIVISION 6

WOODS AND PLASTERS

Castle Valley Consultants, Inc.
Engineers • Planners • Design Professionals
10 Beulah Road, New Britain, Pa. 18901
Phone (215) 348-8257 Fax (215) 348-8267
Web: www.casval.com

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SECTION 06105

MISCELLANEOUS CARPENTRY

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the followings:

1. Framing with dimension lumber
2. Wood blocking, cants, and nailers
3. Wood furring and grounds
4. Sheathing
5. Shelving and clothes rods
6. Plywood backing panels

B. Related Sections include the following:

1. Division 6 Section "Finish Carpentry" for nonstructural carpentry items exposed to view and not specified in another Section.
2. Division 6 Section "Exterior Architectural Woodwork."

1.03 DELIVERY, STORAGE; AND HANDLING

A. Stack lumber, plywood, and other panels; place spacers between each bundle to provide air circulation. Provide for sir circulation around stacks and under coverings.

PART 2 PRODUCTS

2.01 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of lumber grading agencies certified by the American Lumber Standards Committee Board of Review.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
3. Provide dressed lumber, S4S, unless otherwise indicated.

4. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2-inch nominal (38 mm actual) thickness or less, unless otherwise indicated.

B. Wood Structural Panels:

1. Plywood: Either DOC PS 1 or DOC PS 2, unless otherwise indicated.

2. Oriented Strand Board: DOC PS 2.

3. Thickness: As needed but not less than thickness indicated.

4. Factory mark panels according to indicated standard.

2.02 WOOD PRESERVATIVE TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA C2 (lumber) and AWPA C9 (plywood), except that lumber that is not is contact with the ground and is continuously protected from liquid water may be treated according to AWPA C31 with inorganic boron (SBX).

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and one of the following:

a. Chromated copper arsenate (CCA)

b. Ammoniacal copper zinc arsenate (ACZA)

c. Ammoniacal, or amine, copper quat (ACQ)

2. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

B. Kiln dry material after treatment to maximum moisture content of 19 percent for lumber and 15 percent for plywood. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark each treated item with the treatment quality mark of an inspection agency approved by the American Lumber Standards Committee Board of Review.

1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece, or omit marking and provide certificates of treatment compliance issued by inspection agency.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.

3. Wood framing members less than 18 inches (460 mm) above grade.

4. Wood floor plates that are installed over concrete slabs directly in contact with earth.

2.03 FIRE RETARDANT TREATED MATERIALS

A. General: Where fire retardant-treated materials are indicated, provide materials that comply with performance requirements in AWPA C20 (lumber) and AWPA C27 (plywood). Identify fire-retardant-treated wood with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.

1. Use treatment for which chemical manufacturer publishes physical properties of treated wood after exposure to elevated temperatures, when tested by a qualified independent testing agency according to ASTM D 5664, for lumber and ASTM D 5516, for plywood.

2. Use treatment that does not promote corrosion of metal fasteners.

3. Use Exterior type for exterior locations and where indicated.

4. Use Interior Type A High Temperature (HT), unless otherwise indicated.

2.04 DIMENSION LUMBER

A. General: Provide dimension lumber of grades indicated according to the American Lumber Standards Committee National Grading Rule provisions of the grading agency indicated.

B. Non Load Bearing Interior Partitions: Construction, Stud, or NO. 2 grade and any of the following species:

1. Mixed southern pine; SPIB.

2. Hem fir or Hem-fir (north); NLGA, WCLIB, or WWPA

3. Spruce pine fir (south) or Spruce pine fir, NELMA, NLGA WCLIB or WWPA.

C. Other Framing and items of dimension lumber size, provide: Construction, Stud, or No. 2 grade and any of the following species:

1. Douglas fir larch (north); NLGA.

2. Hem fir (north); NLGA

3. Southern pine; SPIB.

4. Spruce pine fir; NLGA.

2.05 MISCELLANEOUS LUMBER

A. General: Provide lumber for support or attachment of other construction including the following:

1. Equipment bases and support curbs
2. Blocking
3. Cants
4. Nailers
5. Furring
6. Grounds

B. For exposed boards, provide lumber with 15 percent maximum moisture content and any of the following species and grades:

1. Eastern white pine, Idaho white, lodgepole, ponderosa, or sugar Pine; D Select (Quality) grade; NELMA NLGA, WCLIB or WWPA.
2. Western red cedar; A grade; NLGA or WWPA

C. For concealed boards, provide lumber with 15 percent maximum moisture content and any of the following species and grades:

1. Hem fir or Hem fir (north), Construction or 2 Common grade; NLGA, WCLIB, or WWPA.
2. Spruce pine fir (south) or Spruce-pine-fir, Construction or 2 Common grade, NELMA, NLGA, WCLIB, or WWPA.
3. Eastern softwoods, No. 2 Common grade; NELMA.

2.06 INTERIOR WOOD TRIM

A Lumber Trim for Opaque Finish (Painted): Finished lumber (S4S), either finger jointed or solid lumber, of one of the following species and grades:

1. Grade D Select eastern white pine; Idaho white, lodgepole, ponderosa, or sugar pine.
2. Poplar, maple, birch.

2.07 PANEL PRODUCTS

A Miscellaneous Concealed Plywood: Where indicated: Exterior sheathing, span rating to suit framing is each location, and thickness as indicated but not less than 1/2 inch (13 mm).

B. Miscellaneous Concealed Oriented Strand Board: Where indicated: Exposure 1 sheathing, span rating to suit framing in each location, and thickness as indicated but not less than 1/2 inch.

C. Miscellaneous Exposed Plywood: DOC PS 1, A D Interior, thickness as indicated but not less than 1/2 inch

D. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C D Plugged, fire retardant treated, in thickness indicated or, if not indicated, not less than 1/2 inch thick.

2.08 FASTENERS

A. General: Provide fasteners of size and type indicted that comply with requirements specified in this Article for material and manufacture.

1. Where carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with hot dip zinc coating complying with ASTM A 153/A 153M or of Type 304 stainless steel.

B. Nails, Wire, Brads, and Staples: FS FF-N-105.

C. Power Driven Fasteners: CABO NER 272.

D. Wood Screws: ASME B18.6.1.

E. Screws for Fastening to Cold Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

F. Lag Bolts: ASME B 18.2.1. (ASME B 18.2.3.8M).

G. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

H. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Material: Carbon steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

2.09 METAL FRAMING ANCHORS

A. General: Provide galvanized steel framing anchors of structural capacity, type, and size indicated and acceptable to authorities having jurisdiction.

B. Galvanized Steel Sheet: Hot dip, zinc coated steel sheet complying with ASTM A 653/A 653M, G60 (Z180) coating designation.

2.10 GYPSUM SHEATHING BOARD

A. Glass mat gypsum sheathing shall conform to ASTM C 79/C 79M and ASTM C 1177/C 1177M. Gypsum board shall conform to ASTM C 79/C 79M, 1/2 inch thick, 4 feet wide with straight edges for supports 16 inches on center without corner bracing of framing or for supports 24 inches on center with corner bracing of framing; 2 feet wide with V-tongue and groove edges for supports 16 or 24 inches on center with corner bracing of framing.

PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

B. Apply field treatment complying with AWPA M4 to cut surfaces of preservative treated lumber and plywood.

C. Securely attach carpentry work as indicated and according to applicable codes and recognized standards.

D. Use fasteners of appropriate type and length. Predrill members when necessary to avoid splitting wood.

3.02 WOOD GROUND, SLEEPER, BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicted and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

3.03 WOOD FURRING INSTALLATION

A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finished work.

1. Fire block furred spaces of walls, at each floor level and at ceiling, with wood blocking or noncombustible materials accurately fitted to close furred spaces.

B. Furring to Receive Plywood or Hardboard Paneling: Install l by 3 inch nominal (19 by 63 mm actual) size furring as indicated, of if not indicated, horizontally and vertically at 16 inches O.C.

3.04 PANEL PRODUCT INSTALLATION

A. Wood Structural Panels: Comply with applicable recommendations contained in APA Form No. E30K, “APA Design/Construction Guide: Residential & Commercial," for types of structural use panels and applications indicated.

3.05 WOOD TRIM INSTALLATION

A. Install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches (610 mm) long except where necessary. Stagger joints in adjacent and related standing and running trim. Cope at returns and miter at corners to produce tight fitting joints with full-scale contact throughout length of joint. Use scarf joints for end-to-end joints.

1. Match color and grain pattern across joints.

2. Install trim after gypsum board joint finishing operations are completed.

3. Drill pilot holes in hardwood before fastening to prevent splitting. Fasten to prevent movement or warping. Countersink fastener heads and fill holes.

4. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.

3.06 PARTITION AND WALL FRAMING

A. Unless otherwise shown, studs shall be spaced 16 inches on centers. Studs shall be doubled at openings. Unless otherwise indicated, headers for openings shall be made of two pieces of stud material set on edge or solid lumber of equivalent size, and corners shall be constructed of not less than three full members. End studs of partitions abutting concrete or masonry shall be anchored thereto with expansion bolts, one near each end of each stud and at intermediate intervals of not more than 4 feet. Plates of partitions resting on concrete floors shall be anchored in place with expansion bolts, one near each end of each piece and at intermediate intervals of not more than 6 feet between bolts. In lieu of expansion bolts, anchoring into concrete may be accomplished with powder-driven threaded studs of suitable type and size and spaced at 3 feet on center. Walls and load bearing partitions shall be provided with double top plates with members lapped at least 2 feet and well spiked together.

3.07 GYPSUM BOARD

A. Sheathing shall be applied with edges in light contact at joints and nailed in accordance with the manufacturer's approved instructions. Sheets 2 feet wide shall be applied horizontally with tongued edge up, with vertical joints over supports, and with vertical joints staggered. Sheets 4 feet wide shall be applied vertically, extended over top and bottom plates, and with all vertical and horizontal joints over supports.

END OF SECTION

SECTION 06200

FINISH CARPENTRY

PART 1 GENERAL

1.01 A. This section includes the following:

1. Standing and running trim.
2. Wood Ceilings.
3. Paneling.
4. Exterior Board and Batten Siding.

B. See Division 6 Section "Exterior Architectural Woodwork" for exterior Woodwork not specified in this Section.

1.02 SUBMITTALS

A. Product Data: For each type of factory-fabricated product and process indicated.

B. Samples: For the following:

1. Each type of paneling required.
2. Each type of siding required.

PART 2 PRODUCTS

2.01 MATERIALS, GENERAL

A. Lumber Standards: Comply with DOC PS 20, "American Softwood Lumber Standard," for lumber and with applicable grading rules of inspection agencies certified by the American Lumber Standards Committee Board of Review.

B. Softwood Plywood: Comply with DOC PS 1, "U.S. Product Standard. For construction and Industrial Plywood."

C. Hardwood Plywood: Comply with HPVA HP-1, "Interim Voluntary Standard for Hardwood and Decorative Plywood."

D. Preservative Treatment: Comply with NWWDA I.S. 4 for exterior finish Carpentry to receive water-repellent preservative treatment.

E. Fire-Retardant Treatment: Where indicated, use materials impregnated With fire-retardant chemicals per AWPA C20; exterior type of interior Type A as required.

2.02 STANDING AND RUNNING TRIM

A. Exterior Standing and Running Trim: Finish lumber and moldings.

1. Species and Grade: Saw-textured, Clear Heart, western red cedar or Smooth-textured, B & B, pine; SPIB as indicated.

2. Size as indicated.

B. Shelving: ¾-inch (19 mm) particleboard shelving with 1x2 hardwood front edge, painted

C. Interior Window Casing and sills:

1. Plastic Laminate, High-Pressure Decorative Laminate: NEMA LD 3.

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

a. Formica Corporation

b. Laminart.

c. Pioneer Plastics Corp.

d. Wilsonart International; Div. of Premark International, Inc.

3. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with ANSI Z124.3, for Type 5 or Type 6 material and performance requirements, without a pre-coated finish.

4. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

5. Products: Subject to compliance with requirements, provide one of the following:

a. Dupont Polymers; Corian.

b. Swan Corporation (The); Swanstone.

c. Wilsonart International, Div. of Premark International, Inc.; Gibraltar.

2.03 STAIRS AND RAILINGS

A. Exterior Stair Treads: 1-inch kiln-dried, pressure-preservative-treated, southern yellow pine, B & B stepping with half round nosing.

B. Exterior Railings: Clear, kiln-dried, pressure-preservative-treated, southern yellow pine railing stock of pattern and fabrication indicated.

2.04 SIDING

A. Siding (Battens): Rigid Expanded Foam Polyvinyl Chloride (PVC) with

max density of 0.55 g/cm3 (5/8" x 1 5/8") as manufactured by AZEK or Approved equal.

B. Cementitious Hardboard Siding: ANSI/AHA A135.6, primed with manufacturer's standard exterior enamel primer.

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. James Hardi.

b. Cem plank

c. Georgia Pacific

2. Type: 5/16" flat boards, Hardi-board, 12" (10 ½" exposure),

3. Texture: Wood-grain textured.

2.05 MISCELLANEOUS MATERIALS

A. Fasteners for Exterior Finish Carpentry: Provide nails of stainless steel, hot-dip galvanized steel, or non-corroding aluminum.

PART 3 EXECUTION

3.01 PREPARATION

A. Condition finish carpentry to average prevailing humidity conditions in installation areas before installation, for a minimum of 24 hours.

B. Prime and backprime lumber for painted finish exposed on the exterior. Comply with requirements for surface preparation and application in Division 9 Section "Painting."

3.02 INSTALLATION

A. Install finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where required for alignment. Scribe and cut finish carpentry to fit adjoining work. Refinish and seal cuts.

B. Standing and Running Trim: Install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Stagger joints in adjacent and related trim. Cope at returns and miter at corners.

C. Siding: Install siding and flashing according to manufacturer's written recommendations. Do not allow nails to penetrate more than one thickness of siding, unless otherwise recommended by siding manufacturer. Seal joints at inside and outside corners and at trim locations.

D. Repair damaged or defective finish carpentry where possible to eliminate functional or visual defects. Where not possible to repair, replace finish carpentry. Adjust joinery for uniform appearance.

END OF SECTION

DIVISION 7

THERMAL AND MOISTURE PROTECTION

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SECTION 07160

BITUMINOUS DAMPPROOFING

PART 1 GENERAL

1.01 WORK INCLUDED

A. Cold applied asphalt dampproofing.

B. All subgrade exterior surfaces of masonry foundation walls shall receive dampproofing. Cast in place tanks, structures and precast concrete structure subgrade surfaces shall receive coating specified in Section 09905.

1.02 REFERENCES

A. ANSI/ASTM D449 - Asphalt Used in Dampproofing and Waterproofing.

B. National Roofing Contractors Association (MRCA - Waterproofing Manual).

1.03 SUBMITTALS

A. Submit product data under provisions of Section 01300.

PART 2 PRODUCTS

2.01 BITUMEN MATERIALS

A. Asphalt: ANSI/ASTM D449, Type I. II, III.

B. Asphalt Primer: ANSI/ASTM D41, compatible with substrate.

C. Asphaltic Sealing Mastic: ANSI/ASTM D491.

2.02 ACCESSORIES

A. Protection Board: 1/8-inch thick biodegradable hardboard, asphalt impregnated wood fiberboard, or bitumen impregnated glass.

PART 3 EXECUTION

3.01 INSPECTION

A. Verify surfaces are solid, free of frozen matter, loose particles, cracks, pits, rough projections, and foreign matter detrimental to adhesion and application of dampproofing.

B. Do not apply dampproofing to damp, frozen, dirty, or dusty surfaces unacceptable to applicator.

C. Verify items, which penetrate surfaces to receive dampproofing, are securely installed.

D. Beginning of installation means acceptance of substrate.

3.02 PREPARATION

A. Clean and prepare surfaces to receive dampproofing in accordance with manufacturer's instructions.

B. Apply mastic to seal penetrations, small cracks, and honeycomb in substrate.

3.03 APPLICATION

A. Prime surfaces in accordance with manufacturer's instructions. Permit primer to dry.

B. Apply cold bitumen with mop, roller or spray.

C. Apply two coats, continuous and uniform at a rate in accordance with manufacturer's instructions.

D. Apply from 2 inches below finish grade elevation to top of footings.

E. Seal watertight items projecting through dampproofing surface with mastic.

3.04 PROTECTION

A. Immediately backfill against membrane to protect from damage.

B. Protect finished dampproofing from damage during backfill operations by adhering protection board with mastic over treated surfaces.

C. Neatly fit boards around pipes and projections.

D. Backfill against protection board to prevent injury to membrane.

3.05 SCHEDULE

A. Apply dampproofing at all exterior masonry and concrete surfaces from above the lowest floor line to finished grade.

END OF SECTION

SECTION 07210

BUILDING INSULATION

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes the following:

1. Insulation under slabs-on-grade.
2. Foundation wall insertion (supporting backfill).
3. Concealed burg insulation.
4. Roof or ceiling insulation: Glass mineral fiber batt insulation
5. Vapor retarders.

1.02 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84 for surface-burning characteristics and other methods indicated with product, by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and-inspecting agency.

PART 2 PRODUCTS

2.01 INSULATING MATERIALS

A. General: Provide insulating materials that comply with requirements and with referenced standards and, for preformed units, in sizes to fit applications indicated, selected from manufacturer's standard thicknesses, widths, and lengths, unless noted otherwise.

B. Extruded-Polystyrene Board Insulation: ASTM C 578, VII, 2.20 Ib/cu. ft. with maximum flame-spread and smoke-developed indices of 75 and 450, respectively.

C. Mineral-fiber blanket insulation consisting of fibers manufactured from glass, slag wool, or rock wool:

1. Unfaced Mineral-Fiber Blanket Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indices of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

2. Faced Mineral-Fiber Blanket Insulation: ASTM C 664 Type III, Class A; Category 1, faced with foil-scrim-draft, foil-scrim, or foil-scrim- polyethylene vapor-retarder membrane on one face.

3. Acoustic Insulation: See "Gypsum Board Assemblies"

2.02 VAPOR RETARDERS

A. Polyethylene Vapor Retarder: ASTM D 4397, 6 mils thick, with maximum permeance rating of 0.13 perm.

B. Reinforced-Polyethylene Vapor Retarders: 2 outer layers of polyethylene film. Laminated to an inner reinforcing layer consisting of either nylon cord or polyester scrim and weighing not less than 25 lb/1000 sq. ft., with maximum permeance rating of 0.0507 perm.

C. Fire-Retardant, Reinforced-Polyethylene Vapor Retarders: 2 outer layers of polyethylene film laminated to an inner reinforcing layer consisting of either a nonwoven grid of nylon cord of polyester scrim and weighing not less than 22 lb/1000 sq. ft., with maximum permeance ratio of 0.1317 perm. and flame-spread and smoke-developed indices of not more than 5 and 60, respectively.

2.03 AUXILLARY INSULATING MATERIALS

A. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.

B. Install perimeter insulation on vertical surfaces by setting units in adhesive.

1. If not otherwise indicated, extend insulation a minimum of 24 inches (610 mm) below exterior grade line.

2. Protect below-grade insulation on vertical surfaces from damage during backfilling by applying protection board set in adhesive.

C. Protect top surface of perimeter under slab insulation from damage during concrete work by applying protection board.

D. Installation of General Building Insulation: Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

1. Set vapor-retarder-faced units with vapor retarder to warm side of construction, unless otherwise indicated. Do not obstruct ventilation spaces, except for Firestopping.

a. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.

2. Install mineral-fiber blankets in cavities formed by framing members according to the following requirements:

    a. Use blanket widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill cavity, proved lengths that will produce a snug fit between ends.

    b. Place blankets in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members. Note: use of engineered trusses in roof will require actual, not nominal, insulation widths to fill entire joist space.

3. For metal-framed wall cavities where cavity heights exceed 96 inches 92438 mm) support unfaced blankets mechanically and support faced blankets by taping stapling flanges to flanges of metal studs.

4. Retain insulation in place by metal clips and straps or integral pockets within window frames, spaced at intervals recommended in writing by insulation manufacturer to hold dimension indicated between insulation and glass.

5. Install insulation where it contacts perimeter fire-containment system to prevent insulation from bowing under pressure from perimeter fire-containment system.

6. Stuff glass-fiber, loose-fill insulation into miscellaneous voids and cavity spaces where shown. Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. Ft. (40 kg/cu. m).

E. Installation of Vapor Retarders: Extend vapor retarder to extremities of areas to be protected from vapor transmission. Secure in place with adhesives or other anchorage system as indicated. Extend vapor retarder to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.

1. Seal vertical joints in vapor retarders over framing by lapping not less than two wall studs. Fasten vapor retarders to framing at top, end, and bottom edges; at perimeter of wall openings; and at lap joints. Space fasteners 16 inches (406 mm) o.c. Max.

2. Seal overlapping joints in vapor retarders with adhesives or vapor- retarder tape according to vapor-retarder manufacturer's instructions. Seal butt joints and fastener penetrations with vapor-retarder tape. Locate all joints over framing members of other solid substrates.

3. Firmly attach vapor retarders to substrates with mechanical fasteners or adhesives as recommended by vapor-retarder manufacturer.

4. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor retarder tape to create an airtight seal between penetrating objects and vapor retarder.

5. Repair any tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarder.

END OF SECTION

SECTION 07311

ASPHALT ROOF SHINGLES

PART 1 GENERAL

1.01 SUMMARY

A This Section inches asphalt shingles for steep pitched roofs.

1.02 SUBMITTALS

A Product Data: For each product indicated.

B. Samples: Two full-size units for each asphalt shingle indicated and for each color and texture required.

1.03 QUALITY ASSURANCE

A. Fire-Test-Exposure Classification: Identify each bundle of shingles or shakes with appropriate markings indicating fire test-exposure classification.

B. Wind-Resistance-Test Characteristics: Identify each bundle of asphalt shingles with appropriate markings indicating wind-resistance test characteristics.

1.04 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to furnish replacement shingles or refund pro-rata portion of amount originally paid for shingles that fail due to original product defects within 30 years from date of Substantial Completion. Failures include, but are not limited to, leaks or deformation or deterioration of asphalt shingles beyond normal weathering.

PART 2 PRODUCTS

2.01 ASPHALT SHINGLES

A. Available Products: Subject to compliance with requirements, products that may be

incorporated into the Work include, but are not limited to, the following:

1. GAF Building Materials Corporation; Timberline 30 year shingles or approved equal.

B. Colors, Blends, and Patterns: As selected by owner from manufacturer's full range.

C. Three-Dimensional, Fiberglass, Laminated Strip Shingles: ASTM D 3018, Type I, and

ASTM D 3462, mineral surfaced, self-sealing, laminated, multi-ply overlay construction, fiberglass based.

1. Wind Resistance: Passes requirements in ASTM D 3161.

2. Fire-Test-Response Classification: Class A per ASTM E 108.

D. Hip and Ridge Shingles: Factory-precut matching asphalt shingles.

2.02 METAL TRIM AND FLASHING

A Sheet Metal Materials:

1. Aluminum: ASTM B 209 (ASTM B 209M), alloy 3003-H14 with mill finish, minimum 0.024 inch (0.6 mm) thick, unless otherwise indicated.

B. Metal Drip Edge: Brake-formed sheet metal with at least 2-inch (50-mm) roof deck flange and 1-1/2 inch (38-mm) fascia flange with 3/8-inch (9.6-mm) drip at lower edge. Furnish in lengths of 8 or 10 feet (2.5 or 3 m).

1. Material: Aluminum. Verify color with Owner to coordinate with roof and wall colors.

C. Metal Flashing: Job-cut to sizes and configurations required.

1. Material: Copper

D. Vent Pipe Flashing: Lead, ASTM B 749, Type L51121, at least 1/16 inch (1.6 mm) thick, unless otherwise indicted. Provide lead sleeve sized to slip over and turn down into pipe, soldered to skirt at slope of roof extending at least 4 inches (100 mm) from pipe onto roof.

2.03 ACCESSORIES

A. Felt Underlayment: ASTM D 226 or ASTM D 4869, Type I (No.15), 36-inch wide, asphalt-saturated organic felt.

B. Waterproof Underlayment: ASTM D 1970, minimum 40-mil- thick, self-adhering, polymer modified, bituminous sheet membrane. Provide primer when recommended by underlayment manufacturer at eaves and valleys;

1. Products

a. WinterGuard; CertainTeed Corporation

b. Bituthene Ice and Water Shield; Grace: W.R. Grace & Co.

c. Nordshield Ice and WaterGard; Nord Bitumi US, Inc.

d. Polyguard Deck Guard; Polyguard Products; Inc.

e. Eaveguard by Monsey Bakor, self-adhering shingle underlayment

C. Ridge Vent: High-density polypropylene, non-woven modified polyester, or other UV-stabilized plastic designed to be installed her asphalt shingles at ridge.

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. GAF Building Materials Corporation; Cobra Ridge Vent

    b. COR-A-VENT, INC, Ridge Vent

    c. Obdyke, Benjamin, Inc.; Roll Vent

    d. Trimline Roof Ventilation Systems; Trimline

E. Asphalt Plastic Cement: Non-asbestos fibrated asphalt cement, complying with ASTM D 4586.

F. Nails: Aluminum or hot-dip galvanized steel, 0.120-inch- diameter barbed shank, sharp-pointed, conventional roofing nails with minimum 3/8-inch-diameter head and of sufficient length to penetrate 3/4 inch into solid decking or at least 1/8 inch through plywood sheathing.

1. Where nails are in contact with flashing, prevent galvanic action by providing nails made from the same metal as that of flashing.

PART 3 EXECUTION

3.01 PREPARATION

A. Clean substrates of projections and substances detrimental to application. Cover knotholes or other minor voids in substrate with sheet metal flashing secured with non-corrosive roofing nails.

B. Coordinate installation with flashings and other adjoining work to ensure proper sequencing. Do not install roofing materials until all vent stacks and other penetrations through roof sheathing have been installed and are securely fasted against movement.

3.02 INSTALLATION

A. General: Comply with manufacturer's written instructions and recommendations but not less than those recommended by ARMA's "Residential Asphalt Roofing Manual" or NRCA's "The NRCA Steep Roofing Manual."

1. Proceed with installing asphalt shingles only when existing and forecasted weather conditions will permit work to be performed according to manufacturers' written recommendations and warranty requirements, and when substrate is completely dry.

2. Fasten asphalt shingles to roof sheathing with nails.

B. Felt Underlayment: Apply 1 layer of felt underlayment horizontally over entire surface to receive asphalt shingles, lapping succeeding courses minimum of 2 inches, end laps minimum of 4 inches, and hips and valleys minimum of 6 inches. Secure felt with

sufficient number of fasteners to hold underlayment in place until asphalt shingle installation.

1. Omit felt underlayment at areas of waterproof underlayment. Lap felt underlayment over waterproof underlayment as recommended in writing by manufacturer but not less than 2 inches.

C. Waterproof Underlayment: Apply waterproof underlayment at eaves and valleys. Cover deck from eaves to at least 24 inches (600 mm) inside exterior wall line.

D. In addition to eaves, apply waterproof underlayment as well as felt underlayment along all, ridges, valleys, at rake edges, around dormers and at all changes of planes. Lap joints 6".

1. 36" continuous sheet in valleys and at perimeter of eaves. Lap end joints 6", side joints 3".

2. 36" wide around all roof projections

3. Do not leave exposed more than 30 days. Comply with manufacturer's requirements.

E. Underlayment at Closed Valleys: Center 36-inch- wide felt underlayment in valley and secure with only enough fasteners to hold in place until asphalt shingles are installed. Lap roof underlayment over valley underlayment at least 6 inches.

F. Flashing: Install metal flashing and trim as indicated and according to details and recommendations in NRCA's "The NRCA Steep Roofing Manual", "Asphalt Roofing" Section, and in ARMA's "Residential Asphalt Roofing Manual". Install dark colored step flashing up vertical surfaces of parapet walls and counter flash under white metal copings.

G. Install asphalt shingles, beginning at roof's lower edge, with starter strip of roll roofing or inverted asphalt shingles with tabs removed.

1. Cut and fit asphalt shingles at valleys, ridges, and edges to provide maximum weather protection. Provide same weather exposure at ridges as specified for roof. Lap asphalt shingles at ridges to shed water away from direction of prevailing wind

H. Ridge Vents: Install according to manufacturer's written instructions.

END OF SECTION

SECTION 07900

JOINT SEALERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. The required applications include, but are not necessarily limited to the following:

1. Concrete construction joints

2. Joints at doors, windows and other built-in items

1.02 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Manufacturer's Data, Joint Sealers

1. For information only, submit two copies of manufacturer's specifications, recommendations and installation instructions for each type of material required. Include manufacturer's published data, or letter of certification, or certified test laboratory report, indicating that each material complies with the requirements and is intended generally for the applications shown. Show by transmittal that one copy of each recommendation and instruction has been distributed to the Installer.

C. Samples, Joint Sealers

1. Submit samples of each color required (except black) for each type of joint sealer exposed to view.

1.03 QUALITY ASSURANCE

A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

1.04 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Comply with the reference specifications of the GENERAL REQUIREMENTS.

B. Federal Specifications:

TT-S-001543A Sealing Compound, Silicone Rubber Base, (Calking, Sealing and Glazing in Buildings and Other Structures).

TT-S-00230C(2) Sealing Compound, Elastomeric Type, Single Component, (For Calking, Sealing, and Glazing in Buildings and Other Structures).

1.05 PRODUCT HANDLING

A. Deliver sealants to the jobsite in sealed containers, each bearing manufacturer's name and product designation.

B. Store and protect sealant products from damage, deterioration, and contamination in accordance with manufacturer's written recommendations.

1.06 ENVIRONMENTAL CONDITIONS

A. Weather Conditions: Do not proceed with installation of sealants under adverse weather conditions, or when temperatures are below or above manufacturer's recommended limitation for installation. Proceed with the work only when forecasted weather conditions are favorable for proper cure. Wherever joint width is affected by ambient temperature variations, install elastomeric sealants only when temperatures are in the lower third of manufacturer's recommended installation temperature range.

1.07 GUARANTEE

A. Sealed Joints: Against adhesive and cohesive failure of sealant and for watertightness of sealed joints for a period of [5 years] after date of final completion of sealants.

PART 2 PRODUCTS

2.01 MATERIALS

A. Like Items of Materials: End products of one manufacturer to achieve standardization for appearance, maintenance, and replacement.

B. CONTRACTOR Option: Immersible sealant may be substituted for non-immersible sealant of the same material.

C. Characteristics:

1. Uniform, homogeneous.

2. Free from lumps, skins, and coarse particles when mixed.

3. Nonstaining, nonbleeding.

4. Hardness of 15 minimum and 50 maximum, measured by Method ASTM C 661.

2.02 SEALANT MATERIALS

A. Type 1 - Silicone, Non-sag, Not Immersible:

1. Silicone base, single-component, chemical curing; ASTM C 920, Type S, Grade NS, Class 25; Federal Specification TT-S-001543, non-sag type, Class A;

2. Capable of withstanding movement up to 50 percent of joint width.

3. Manufacturer:

    a. Dow Corning Corp. No. 790

    b. General Electric Silpruf

    c. Sonneborn Sonolastic Omniseal

    d. Approved equal

B. Type 2 - Multi-Part Polyurethane, Self-Leveling, Immersible:

1. Polyurethane base, multi-component, chemical curing; ASTM C 920, Type M, Grade P, Class 25 and Federal Specification TT-S-00227, self-leveling Type I, Class A.

2. Capable of being continuously immersed in water.

3. Manufacturer:

    a. Sonneborn Sonolastic Paving Joint Sealant

    b. Pecora Corp. Urexspan NR-200;

    c. H. S. Peterson Co. Iso-Flex 880GB

    d. Mameco International Vulkem 245

    e. Approved equal.

C. Type 3 - Multi-Part Polyurethane, Non-sag, Immersible:

1. Polyurethane base, multi-component, chemical curing; ASTM C 920, Type M, Grade NS, Class 25 and Federal Specification TT-S-00227, non-sag Type II, Class A.

2. Capable of being continuously immersed in water.

3. Manufacturer:

    a. H. S. Peterson Co. Iso-Flex 881

    b. Mameco International Vulkem 922

    c. Product Research Corp. PRC 270

    d. Sonneborn Sonolastic NP-II

    e. Approved equal.

D. Type 4 - Multi-Part Polyurethane, Non-sag, Not Immersible:

1. Polyurethane base, multi-component, chemical curing; ASTM C 920, Type M, Grade NS, Class 25 and Federal Specification TT-S-00227, non-sag Type II, Class A.

2. Manufacturer:
    a. Sonneborn Sonolastic NP-II
    b. Pecora Corp. Dynatrol II
    c. Tremco Dymeric
    d. H. S. Peterson Co. Isoflex 2000
    e. Mameco International Vulkem 227
    f. Approved Equal

E. Type 5 - One-Part Polyurethane, Immersible:

1. Polyurethane base, single-component, chemical curing; Federal Specification TT-S-00230, Type I or II, Class A.
2. Capable of being continuously immersed in water, withstand movement of up to 25 percent of joint width.
3. Manufacturer for Non-sag:
    a. Sonneborn Sonolastic NP-I
    b. Sika Chemical Corp., Sikaflex-1a No. 430
    c. Mameco International Vulkem 116
    d. Approved equal
4. Manufacturer for Self-Leveling:
    a. Sonneborn Sonolastic SL-1
    b. Mameco International Vulkem 45
    c. Sika Chemical Corp. Sikaflex 12SL
    d. Approve Equal.

F. Type 6 - One-Part Polyurethane, Not Immersible:

1. Polyurethane base, single-component, chemical curing; ASTM C 920, Type S, Grade NS, Class 25 and Federal Specification TT-S-00230, non-sag Type II, Class A.
2. Manufacturer:
    a. Pecora Corp. Dynatrol I
    b. Tremco Dymonic

c. Sonneborn Sonolastic NP-I

d. Approved equal.

G. Type 7 - Multi-Part Polysulfide, Immersible:

1. Polysulfide base, two-component, chemical curing; ASTM C 920, Type M, Grade P or NS, Class 25 and Federal Specification TT-S-00227, Type I self-leveling, Type II nonsagging, Class A, uniform, homogeneous and free from lumps, skins, and coarse particles when mixed.

2. Capable of being continuously immersed in water.

3. Manufacturer:

a. W. R. Meadows CM-60, two-part

b. Sonneborn Sonolastic Two

c. Approved equal.

H. Type 8 - One-Part Polysulfide, Non-sag, Not Immersible:

1. Polysulfide base, single-component, chemical curing; ASTM C 920, Type S, Grade NS, Class 12 1/2; Federal Specification TT-S-00230, Type II non-sag, Class A;

2. Capable of withstanding movement up to 20 percent of joint width.

3. Manufacturer:

a. W. R. Meadows CM-60, one-part

b. Sika Chemical Corp. Sikaflex 440

c. Product Research Corp. PRC 7000

d. Approved equal.

I. Type 9 - One-Part Acrylic Terpolymer, Non-sag, Not Immersible:

1. Acrylic base, single-component, solvent curing; Federal Specification TT-S-00230, Type I non-sag, Class B.

2. Capable of withstanding movement up to 7.5 percent of joint width; Shore "A" hardness of 55 maximum.

3. Manufacturer:

a. Pecora Chemical Corp. 60 + Unicrylic

b. Tremco Mono

c. Approved equal.

2.03 BACKUP MATERIAL

A. Nongassing, extruded, closed-cell round polyethylene foam rod, compatible with sealant used, and as recommended by sealant manufacturer.

B. Size: As shown or as recommended by sealant material manufacturer. Provide for joints greater than 3/16-inch wide.

C. Manufacturer:

1. Haveg Industries Minicel
2. Dow Corning Ethafoam SB
3. Sonneborn Sonofoam;
4. Hercules, Inc., HBR
5. Approved equal.

2.04 BOND BREAKER

A. Pressure Sensitive Tape: Recommended by sealant manufacturer to suit application.

2.05 JOINT CLEANER

A. Noncorrosive and nonstaining type, recommended by sealant manufacturer; compatible with joint forming materials.

2.06 PRIMER

A. Nonstaining type recommended by sealant manufacturer to suit application.

2.07 SEALANT COLOR

A. Unless specifically noted, match the color of the principal wall material adjoining the area of application.

2.08 TAPE SEALANT

A. Closed cell polyvinyl chloride (PVC) foam coated on both sides with a modified acrylic pressure-sensitive adhesive.

B. Color: Black.

C. Size: 3/4-inch width by length as required by thickness as recommended by manufacturer, for particular application.

D. Properties:

1. Tensile Strength (ASTM D 412, Die C): 80 psi.
2. Elongation (ASTM D 412, Die C): 125 percent.

3. Compression Set (ASTM D 1056): 30 percent max.

4. Compression Deflection (ASTM D 1056) at 25 Percent Deflection: 2.5 psi.

5. Low Temperature Flexibility, 5 Hours at -40 Degrees F: No cracking.

6. Heat Resistance/Maximum Shrinkage, 70 Hours at 212 Degrees F: 1.5 percent.

7. Staining (ASTM D 925) on Most Substrates: None.

8. Water Absorption by Weight at 30 Percent Compression: 24 percent.

9. Density per Cubic Foot (ASTM D 3574): 10 pounds.

10. Thermal Conductivity (k factor): 0.24.

2.09 PREFORMED SEALS

A. Preformed Compressible Joint Seals:

1. Widths Up to 5-Inches:

a. Acme Highway Products Corp., Buffalo, NY, Acmaseal J-Series

b. Watson-Bowman Associates, Inc., Buffalo, NY, WA-Series

c. H. S. Peterson Co. Isoflex Neoprene Seal, LS-Series, Pontiac, MI

d. Approve equal.

2. Other Widths: Series or model recommended by seal manufacturer.

PART 3 EXECUTION

3.01 GENERAL

A. Use of more than one material for the same joint is not allowed unless approved by the sealant manufacturer.

B. Install joint sealants in accordance with ASTM C 962.

C. Horizontal and Sloping Joints of 1 Percent Maximum Slope: Use self-leveling (Grade P) joint sealant.

D. Steeper Sloped Joints, Vertical Joints, and Overhead Joints: Use non-sag (Grade NS) joint sealant.

E. Use joint sealant as required for the appropriate application and as follows:

Joint Size	Sealant Type
Less than 1-inch	1,2,3,4,5,6,7,8, or 9
Less than 2-inch	1,2,3,4, or 7
Over 2-inch	As per manufacturer's recommendation

3.02 PREPARATION

A. Verify that joint dimensions and physical and environmental conditions are acceptable to receive sealant.

B. All surfaces to be sealed shall be dry, sound, and free of dust, loose mortar, and other foreign materials.

1. Mask adjacent surfaces where necessary to maintain neat edge.

2. Starting of work will be construed as acceptance of all sub-surfaces.

C. Verify that joint shaping materials and release tapes are compatible with sealant.

D. Examine joint dimensions and size materials to achieve required width/depth ratios.

3.03 INSTALLATION

A. Use joint filler to achieve required joint depths, to allow sealants to perform intended function.

1. Install backup material as recommended by sealant manufacturer.

2. Where possible, provide full-length sections without splices; minimize number of splices.

B. Use bond breaker where recommended by sealant manufacturer.

C. Apply sealant within environmental conditions stated above.

1. Consult manufacturer when sealant cannot be applied within these temperature ranges.

D. Seal all joints around window, door and louver frames, expansion joints, and elsewhere as indicated.

E. Joint Sealant Materials: Follow manufacturer's recommendation and instructions, filling joint completely from bottom to top, without voids.

F. Joints: Tool slightly concave after sealant is installed.

1. When tooling white or light color sealant, use a water-wet tool.

2. Finish joints free of air pockets, foreign embedded matter, ridges, and sags.

G. Tape Sealant: Locate where indicated and install in accordance with manufacturer's instructions.

3.04 PREFORMED SEALS

A. Prepare joint surfaces clean and dry, free from oil, rust, laitance, and other foreign material.

B. Construct joints straight and parallel to each other and at the proper width and depth.

C. Install within environmental conditions stated above.

D. Apply joint sealant manufacturer's approved primer and adhesive in accordance with manufacturer's instructions.

E. Install seal in accordance with manufacturer's instructions.

3.05 CLEANING

A. Clean surfaces next to the sealed joints of smears or other soiling resultant of sealing application.

B. Replace any damaged surfaces resulting from joint sealing or cleaning activities.

C. Clean up and dispose of all waste materials and debris resulting from this operation off the site.

3.06 JOINT SEALANT SCHEDULE

A. This schedule lists the sealant types acceptable for each joint location. Use as few different sealant types as possible to meet the requirements of this project.

Joint Location	Sealant Type(s)
Expansion/Contraction and control Joints at:	
Concrete Walls	1,3,4,5,6,7
Concrete Floor Slabs	2,5
Masonry Walls	1,3,4,5,6,7
Material Joints At:	
Metal Door & Louver Frames (Exterior)	1,5,6,8
Metal Door & Louver Frames (Interior)	1,5,6,8,9
Wall Penetrations (Exterior)	1,5,6,8
Wall Penetrations (Interior)	1,5,6,8
Floor Penetrations	5,6,7
Ceiling/Roof Penetrations	1,3,4,5,6,7
Sheet Metal Flashings	1,3,5,7
Other Joints	
Threshold Sealant Bed	5
Immersed Concrete (Vertical and Sloped)	3,5
Immersed Concrete (Horizontal)	2,5
Openings Around Pipes, Conduits, and Ducts Through Fire-Rated Construction	11
Concrete Form Snap-Tie Holes	1,4,6

END OF SECTION

DIVISION 8

DOORS AND WINDOWS

Castle Valley Consultants, Inc.
Engineers • Planners • Design Professionals
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SECTION 08310

ALUMINUM ACCESS DOOR

PART 1 GENERAL

1.01 SUMMARY

A. Work included: Furnishing and installing factory fabricated vault access doors

1.02 REFERENCES

American Society for Testing and Materials (ASTM),

ASTM A 36-93 Standard Specification for Structural Steel

1.03 SUBMITTALS

A. Product Data: Provide manufacturer's product data for all materials in this specification.

B. Shop Drawings: Show profiles, accessories, location, and dimensions.

C. Samples: Manufacturer to provide upon request; sized to represent material adequately.

D. Contract Closeout: Vault access door manufacturer shall provide the manufacturer's warranty prior to the contract closeout.

1.04 PRODUCT HANDLING

A. All materials shall be delivered in manufacturer's original packaging.

B. Store materials in a dry, protected, well-vented area. The contractor shall thoroughly inspect product upon receipt and report damaged material immediately to delivering carrier and note such damage on the carrier's freight bill of lading.

C. Remove protective wrapping immediately after installation.

1.05 JOB CONDITIONS

A. Verify that other trades with related work are complete before installing vault access door(s).

B. Mounting surfaces shall be straight and secure; substrates shall be of proper width.

C. Refer to the construction documents, shop drawings, and manufacturer's installation instructions.

D. Observe all appropriate OSHA safety guidelines for this work.

1.06 WARRANTY/GUARANTEE

A. Manufacturer's standard warranty: Materials shall be free of defects in material and workmanship for a period of (25) twenty-five years from the date of purchase. Should a part fail to function in normal use within this period, manufacturer shall furnish a new part at no charge.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. The BILCO Company, P.O. Box 1203, New Haven, CT 203-934-6363

B. Halliday Products, 6401 Edgewater Drive, Orlando, Florida 800-298-1027

C. Washington Aluminum Company, 1330 Knecht Ave, Baltimore, MD 410-242-1000

D. Approved Equal

2.02 ACCESS DOOR

A. Furnish and install where indicated on plans vault access door Type J-AL H20 (Single leaf) or Type JD-AL H20 (double leaf). Length denotes hinge side. The vault access door shall be pre-assembled from the manufacturer.

B. Performance characteristics:

1. Cover: Shall be reinforced to support AASHTO H-20 wheel load with a maximum deflection of 1/150th of the span.

2. Operation of the cover shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.

3. Operation of the cover shall not be affected by temperature.

4. Entire door, including all hardware components, shall be highly corrosion resistant. Please consult the manufacturer when doors are to be installed in unusually harsh environments or extremely corrosive conditions.

C. Cover: Shall be 1/4" aluminum diamond pattern.

D. Frame: Channel frame shall be 1/4" extruded aluminum with bend down anchor tabs around the perimeter. A continuous EPDM gasket shall be mechanically attached to the aluminum frame to create a barrier around the entire perimeter of the cover and significantly reduce the amount of dirt and debris that may enter the channel frame.

E. Hinges: Shall be specifically designed for horizontal installation and shall be through bolted to the cover withtamperproof 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" drain coupling located in the right front corner of the channel frame.

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" 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 aluminum hinges, each having a minimum 1/4"diameter Type 316 stainless steel pin, shall be provided and shall pivot so the cover does not protrude into the channel frame.

2. Cover shall be equipped with an hold open arm which automatically locks the cover in the open position.

3. Cover shall be fitted with the required number and size of compression spring operators. Springs shall have an electrocoated acrylic finish. Spring tubes shall be constructed of a reinforced nylon 6/6-based engineered composite material.

4. A Type 316 stainless steel snap lock with fixed handle shall be mounted on the underside of the cover.

5. Hardware: Shall be anticorrosion throughout.

J. Finishes: Factory finish shall be mill finish aluminum with bituminous coating applied to the exterior of the frame.

PART 3 EXECUTION

3.01 INSPECTION

A. Verify that the vault access door installation will not disrupt other trades. Verify that the substrate is dry, clean, and free of foreign matter. Report and correct defects prior to any installation.

3.02 INSTALLATION

A. Submit product design drawings for review and approval to the Engineer before fabrication.

B. The installer shall check as-built conditions and verify the manufacturer's vault access door details for accuracy to fit the application prior to fabrication. The installer shall comply with the vault access door manufacturer's installation instructions.

C. The installer shall furnish mechanical fasteners consistent with the vault access door manufacturer's instructions.

END OF SECTION

DIVISION 9

FINISHES

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SECTION 09671

RESINOUS FLOORING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:

1. General-use epoxy-resin flooring

2. High-performance resinous flooring

B. Related Sections include the following:

1. Division 3 Section "Concrete" for concrete substrates to receive resinous flooring.

1.03 SUBMITTALS

A. Product Data: For each type of product specified. Include manufacturer's technical data, installation instructions, and recommendations for each resinous flooring component required.

B. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors, textures, and patterns available for each resinous flooring system indicated.

C. Samples for Verification: Of each resinous flooring system required, 6 inches (150 mm) square, applied by Installer for this Project to a rigid backing, in color, texture and finish indicated. Where finishes involve normal color and texture variations, include Sample sets showing the full range of variations expected.

D. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.

E. Material Test Reports: From a qualified independent testing agency indicating and interpreting test results of the resinous flooring's reaction to chemicals and other reagents and substantiating compliance with requirements.

F. Material Certificates: In lieu of material test reports, when permitted by Engineer, signed by manufacturers certifying that materials furnished comply with requirements.

G. Maintenance Data: For resinous flooring to include in the maintenance manuals specified in Division 1.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer (applicator) who has specialized in installing resinous flooring similar in material, design, and extent to that indicated for this Project and who is acceptable to resinous flooring manufacturer.

1. Engage an installer who employs only persons trained and approved by resinous flooring manufacturer for installing resinous flooring systems specified.

2. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to install resinous flooring systems specified.

B. Source Limitations: Obtain primary resinous flooring materials, including primers, hardening agents, and sealing or finish coats, through one source from a single manufacturer. Provide secondary materials including patching and fill material, joint sealant, and repair materials of type and from source recommended by manufacturer of primary materials.

C. Field Samples: On floor area selected by Engineer or Owner, provide full-thickness resinous flooring system samples that are at least 48 inches (1200 mm) square to demonstrate texture, color, thickness, chemical resistance, cleanability, and other features of each resinous flooring system required. Simulate finished lighting conditions for review of in-place field samples.

1. If field samples are unacceptable, make adjustments to comply with requirements and apply additional samples until field samples are approved.

2. After field samples are approved, these surfaceswill be used to evaluate resinous flooring.

3 Obtain Engineer’s or Owner's approval of field samples before applying resinous flooring.

4. Final approval of colors will be from field samples, not samples submitted for verification.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with, seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

B. Store materials to comply with manufacturer's written instructions to prevent deterioration from moisture, heat, cold, direct sunlight, or other detrimental effects.

1.06 PROJECT CONDITIONS

A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring installation.

B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring installation.

C. Close spaces to traffic during resinous flooring application and for not less than 24 hrs after application, unless manufacturer recommends a longer period.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Available Products: Subject to compliance with requirements.

2.02 MATERIALS

A. Resinous Flooring: Resinous floor surfacing system consisting of primer; body coats(s) including resin, hardener, aggregates, and colorants, if any; and sealing or finish coat(s). Comply with requirements indicated in the Resinous Flooring Schedule.

1. Waterproofing Membrane: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.

2. Reinforcing Membrane: Manufacturer’s flexible resin recommended for crack isolation to help prevent substrate cracks from reflecting through resinous flooring.

a. Provide fiberglass scrim embedded in reinforcing membrane.

B. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.

C. Joint Sealant: Type recommended or produced by resinous flooring manufacturer for type of service and joint condition indicated.

PART 3 EXECUTION

3.01 PREPARATION

A. General: Prepare and clean substrate according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry, and neutral substrate for resinous flooring application.

1. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written recommendations.

B. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.

C. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.

D. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written recommendations.

3.02 APPLICATION

A. General: Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.

1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate and optimum inter-coat adhesion.

2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.

3. At substrate expansion and isolation joints, provide joint in resinous flooring to comply with resinous flooring manufacturer's written recommendations.

a. Apply joint sealant to comply with manufacturer's written recommendations.

B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.

C. Apply waterproofing membrane, where indicated, in manufacturer's recommended thickness.

1. Apply waterproofing membrane to integral cove base substrates.

D. Apply reinforcing membrane to substrate cracks.

E. Apply reinforcing membrane to entire substrate surface.

F. Apply self-leveling slurry body coat(s) in thickness indicated.

1. Broadcast aggregates and, after resin is cured, remove excess aggregates to provide texture indicated.

G. Apply troweled or screeded body coat(s) in thickness indicated. Hand or power trowel and grout to fill voids. When cured, sand to remove trowel marks and roughness.

H. Integral Cove Base: Apply cove base mix to wall surfaces at locations indicted. Round internal and external corners. Install cove base according to manufacturer's written instructions and details including taping, mixing, priming, troweling, sanding, and topcoating of cove base.

I. Apply sealing or finish coat(s), including grout coat, if any, of type recommended by resinous flooring manufacturer to produce finish indicated. Apply in number of coats and at spreading rates recommended in writing by manufacturer.

3.03 FIELD QUALITY CONTROL

A. Material Sampling: Owner may at any time and any number of times during flooring application require material samples for testing for compliance with requirements.

1. Owner will engage an independent testing agency to take samples of materials being used. Material samples will be taken, identified and sealed, and certified in presence of Contractor.

2. Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures or, if not referenced, using testing procedures listed in manufacturer's Product Data.

3. If test results show installed materials do not comply with specified requirements, pay for testing, remove non-complying materials, prepare surfaces coated with unacceptable materials, and reapply flooring materials to comply with requirements.

3.04 CLEANING AND PROTECTING

A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

B. Clean resinous flooring not more than 4 days before dates scheduled for inspections intended to establish date of Substantial Completion in each Project area. Use cleaning materials and procedures recommended in writing by resinous flooring manufacturer.

3.05 RESINOUS FLOORING SCHEDULE

A. Resinous Flooring:

1. Products: Provide the following or approved equal:

General Polymers; COR-CAST RS

2. Color and Pattern: As selected from manufacturer’s full range of colors and patterns produced for resinous flooring complying with requirements indicated.

3. System Thickness: 90-125 Mils (DFT)

4. Weaning Surface: Anti-slip

5. Base: 4-inch (100-mm-) high integral cove base.

6. Components: Provide manufacturer's standard components complying with requirements, unless otherwise specified.

7. Chemical Resistance: As indicated by system designation and components indicted above.

END OF SECTION

SECTION 09850

CHEMICAL RESISTANT COATING

PART 1 GENERAL

1.01 SUMMARY

A. Work includes high performance chemical resistant epoxy coating system

1.02 QUALITY ASSURANCE

A. Furnish primers, pretreatments, thinners, and finish coats by the same manufacturer

1.03 ENVIRONMENTAL CONDITIONS

A Storage and application temperatures shall be in strict accordance with manufacturer's recommendations

1.04 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Submit copy of manufacturer's Material Safety Data Sheets (MSDS) for each product

C. Product Data: Provide manufacturers catalog literature with capacity, weight, and electrical characteristics and connection requirements.

D. Manufacturer's Installation Instructions

1.05 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 01725.

1.06 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 01730.

B. Maintenance Data: Submit for flooring.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 01600.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Acceptable manufacturers include the following, or equal

1. Tnemec Company, Inc

2.02 MATERIALS

A. Primer shall be compatible with coating, Tnemec Series 201 Epoxoprime, or equal

B. Coating for floor and tank base in chemical containment area shall be chemical resistant, Novolac epoxy coating, Tnemec Series 232 Chemtread, or equal

C. Coating for walls up to 3 feet - 4 inches from floor in chemical containment area shall be Novolac epoxy coating, Tnemec Series 282, or equal

PART 3 EXECUTION

3.01 PREPARATION

A. Surfaces to receive coating shall be cleaned and prepared as recommended by manufacturer.

B. Concrete surfaces shall be abrasive blast cleaned to a texture similar to 40-60 grit sandpaper.

C. A representative of the manufacturer shall observe and approve the surface preparation prior to application of coating

3.02 APPLICATION

A. Mix components in strict accordance with manufacturer's instructions.

B. Surface and material temperature shall be between 70° and 90°, during application.

C. Primer shall be applied at the rate of 160 square feet per gallon.

D. Top coat shall be applied within 4 to 6 hours of prime coat topcoat shall be applied to ¼-inch thickness (100 S.F. /Large Kit), and in accordance with manufacturer's instructions

E. Coating for walls shall be applied as follows

1. One coat Tnemec Series 201 Epoxoprime (160 square feet per gallon)

2. One coat Tnemec Series 282 (180 square feet per gallon)

3. One coat Tnemec Series 282 (250 square feet per gallon)

F. Exposed perimeter edges of topcoat, including doorways, drains, traffic aisle sides, etc shall be "keyed" into substrate to allow full ¼-inch thickness at these points. Saw cut substrate using power saw with carbide or diamond tip blades.

G. Where the concrete floor meets the wall, provide a 45º-angle cove with a height of 1 inch to 2 inches.

H. Do not install coating over expansion joints.

END OF SECTION

SECTION 09905

GENERAL PAINT FINISHES

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall furnish all tools, equipment, materials, and supplies and shall perform all labor required to complete the preparation of surfaces for painting and the painting of all surfaces not specifically included under the requirements of Section 09960 "Protective Coating."

B. Materials not to be painted hereunder shall include the following:

1. Work having complete factory finish other than prime coat.

2. Surfaces whose coatings are for the specific purpose of protection from abrasion, wear and tear, or from corrosion, oxidation, decomposition, or other effects of exposure.

3. Stainless steel, aluminum brass, bronze, and plated finished metals (not zinc or cadmium).

4. Finish hardware except prime-coated items, and fusible links, UL labels, nameplates, numbers, and identifying data.

5. Walking surfaces.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 09960 "Protective Coating": For the purposes of definition, all surfaces listed in the Coating System Schedules of Section 09960 "Protective Coating" shall be deemed to be surfaces requiring such special coating, and in case of conflict between the provisions of Section 09960 "Protective Coating" and Sections specified herein, the provisions of Section 09960 "Protective Coating" shall take precedence.

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Comply with the reference specifications of the GENERAL REQUIREMENTS.

1.04 CONTRACTOR SUBMITTALS

A. Submittals shall be made in accordance with the GENERAL REQUIREMENTS.

B. List of Paint Materials: Prior to submittal of color and gloss samples, the Contractor shall submit for acceptance, a complete list of all paint materials proposed for use, identifying each material by manufacturer's name, product name, and number. The list shall include all primers, thinners, and coloring agents, together with manufacturer's catalog data fully describing each material as to contents, recommended usage, and

preparation and application methods. The Contractor shall identify surfaces to receive various paint materials and shall make no deviations from accepted list. The list shall be submitted within 60 days after execution of the Agreement.

C. Color samples and stain samples shall be submitted as required by the Engineer. Stain samples shall be provided on the same material as the stain will be applied in the final installation.

D. Extra Stock: Upon completion of the project, the Contractor shall provide the OWNER with one gallon or quart of each type and color of paint, depending on quantity used on the project. The cost thereof shall be included as a part of the work required under this Section.

1.05 AIR POLLUTION CONTROL

A. The Contractor shall verify with the authorities having jurisdiction over air pollution control, the use of any materials containing organic chemical compounds use of which at the date of installation may be prohibited or restricted by any regulations then in effect.

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. The paint materials shall be delivered to the job site in the manufacturer's unopened containers and a list of all batch numbers shall be furnished to the Engineer prior to the start of work.

B. Stored paints and liquids shall be kept covered, and precautions shall be taken for the prevention of fire. Empty containers and paint-soiled or oily rags shall be removed from the site at the end of each day's work. Paint thinner shall not be stored in a room scheduled to receive resilient flooring.

1.07 ATMOSPHERIC CONDITIONS

A. No coating shall be applied:

1. When the surrounding air temperature or the temperature of the surface to be coated is below 40 degrees F;

2. To wet or damp surfaces or in rain, fog or mist;

3. When the temperature is less than 5 degrees F above the dewpoint; or

4. When it is expected the air temperature will drop below 40 degrees F, or less than 5 degrees F above the dewpoint within 8 hours after application of coating. Dewpoint shall be measured by use of a sling psychrometer in conjunction with U.S. Department of Commerce Weather Bureau psychrometric tables.

1.08 SAFETY AND HEALTH REGULATIONS

A. General: In accordance with requirements of OSHA Safety and Health Standards for Construction (29CFR1926) and the applicable requirements of regulatory agencies having jurisdiction, as well as manufacturer's printed instructions and appropriate technical bulletins and manuals, the Contractor shall provide and require use of personnel protective lifesaving equipment for persons working in or about the project site.

B. Head and Face Protection and Respiratory Devices: Equipment shall include protective helmets, which shall be worn by all persons while in the vicinity of the WORK. In addition, workers engaged in or near the work during sandblasting shall wear eye and face protection devices and air purifying, halfmask or mouthpiece respirators with appropriate filters. Barrier creams shall be used on any exposed areas of skin.

C. Ventilation: Where ventilation is used to control hazardous exposure, all equipment shall be explosion-proof. Forced air ventilation shall be provided to reduce the concentration of air contaminant to a safe limit. Air circulation and exhausting of solvent vapors shall be continued until coatings have fully cured.

D. Sound Levels: Whenever the occupational noise exposure exceeds maximum allowable sound levels, the Contractor shall provide and require the use of approved ear protective devices.

E. Illumination: Adequate illumination shall be provided while work is in progress, including explosion-proof lights and electrical equipment. Whenever required by the Engineer, the Contractor shall provide additional illumination to cover all areas to be inspected. The Engineer shall determine the level of illumination for inspection purposes.

F. Temporary Ladders and Scaffolding: All temporary ladders and scaffolding shall conform to applicable safety requirements. They shall be erected where requested by the Engineer to facilitate inspection and shall be moved by the Contractor to locations as requested by the Engineer.

1.09 CLEANUP

A. Upon completion of the work, all staging, scaffolding and containers shall be removed from the site or destroyed in a manner approved by the Engineer. Coating spots and oil or stain upon adjacent surfaces shall be removed and the job site cleaned. All damage to adjacent surfaces or facilities resulting from the work performed under the contract shall be cleaned, repaired or refinished to the satisfaction of the Engineer at no additional cost to the OWNER.

1.09 WARRANTY INSPECTION

A. A warranty inspection shall be conducted during the eleventh month following completion of all coating and painting work. The Contractor or its authorized representative shall attend this inspection. All defective work shall be repaired in accordance with the requirements of the Contract Documents and to the satisfaction of the OWNER or Engineer. The OWNER may, by written notice to the Contractor, reschedule the warranty inspection within the contract guarantee period, or may cancel the warranty inspection altogether.

PART 2 PRODUCTS

2.01 MATERIALS

A. Where alternative painting systems are specified, selection from among the alternatives is at the Contractor's option.

B. The Contractor may substitute other paint materials for those specified herein provided that it first receives written approval from the Engineer stating that said proposed substituted materials are equal to those specified and are approved for use in the work.

C. Unless otherwise approved by the Engineer in writing, all coatings applied under a single paint system shall be the products of a single manufacturer.

2.02 FACTORY MIXING

A. To the maximum extent practicable and, unless otherwise approved by the Engineer, each paint shall be factory-mixed to the specified color, gloss, and consistency required for application.

2.03 COATING SYSTEMS

A. Materials used in each system shall be the product of one manufacturer.

B. Shop applied prime coats shall be compatible with the systems included in these specifications.

C. Substituted coating systems shall be of the same generic type as those specified.

D. Coating systems shall not contain lead.

E. Materials: Paints and protective coatings listed in the Paint Systems and the Schedule in 2.04 of this Section refer to the following manufacturers and are specified as levels of quality. It is understood that the words "or equal" are included herein.

- Sherwin Williams (SW)
- Kop Coat (K)
- Tnemec Co. (T)
- Roto Metals (RG)

- Protecto Wrap (PW)
- Tapecoat (TC)
- Chemical Products Co. (ZRC)
- Ameron (A)
- Thermecoat-Welco (TW)
- CRC Industries (CRC)

2.04 COATING SYSTEMS

A. Coating Systems For Factory Primed Steel - Doors, Frames, And Miscellaneous Equipment

1. Exterior Exposed:

a. System Type: Epoxy/urethane.

b. Surface Preparation: Clean and dry.

c. Primer: Factory primed.

d. Intermediate Coat: Series 27 Typoxy. DFT 2.0 to 3.0 mils.

e. Finish Coat: Series 73 Endura-Shield. DFT 2.0 to 3.0 mils.

f. Total DFT: 4.0 to 6.0 mils.

g. Finish Color: As selected by Owner from manufacturer's standard colors

2. Interior Exposed:

a. System Type: Epoxy.

b. Surface Preparation: Clean and dry.

c. Primer: Factory primed.

d. Intermediate Coat: Series 27 Typoxy. DFT 2.0 to 3.0 mils.

e. Finish Coat: Series 66 Hi-Build Epoxoline. DFT 2.0 to 3.0 mils.[4]

f. Total DFT: 4.0 to 6.0 mils.

g. Finish Color: As selected by Owner from manufacturer's standard colors

B. Coating Systems For Precast Concrete, Cast-In-Place Concrete, And Dense Concrete Masonry Units

1. Exterior Exposed:

a. System Type: Acrylic.

b. Surface Preparation: SSPC-SP 13/NACE 6. Clean and dry.

c. Primer: Series 180 W.B. Tneme-Crete. DFT 4.0 to 8.0 mils.

d. Finish Coat: Series 181 W.B. Tneme-Crete. DFT 4.0 to 8.0 mils.

e. Total DFT: 8.0 to 16.0 mils.

f. Finish Color: As selected by Owner from manufacturer's standard colors

2. Below Grade:

a. System Type: Coal tar epoxy.

b. Surface Preparation: SSPC-SP 13/NACE 6. Clean and dry.

c. Primer: None.

d. Finish Coat: 46H-413 Hi-Build Tneme-Tar. DFT 14.0 to 20.0 mils.

e. Total DFT: 14.0 to 20.0 mils.

f. Finish Color: Black.

3. Immersion

a. System Type: Epoxy.

b. Surface Preparation: SSPC-SP 13/NACE 6. Abrasive blast.

c. Primer: Series 66 Hi-Build Epoxoline DFT 4.0 to 6.0 mils.[4]

d. Finish Coat: Series 66 Hi-Build Epoxoline DFT 4.0 to 6.0 mils.

e. Total DFT: 8.0 to 12.0 mils.

f. Finish Color: As selected by Owner from manufacturer's standard colors

C Coating Systems For Concrete Floors (See also Sections 09850 and 09671

1. Light Traffic/Low Impact Exposure:

a. System Type: Epoxy/urethane.

b. Surface Preparation: SSPC-SP 13/NACE 6. Shot blast or mechanically abrade.

c. Primer: Series 66 Hi-Build Epoxoline. DFT 2.0 to 3.0 mils.

d. Final Coat: Series 66 Hi-Build Epoxoline. DFT 2.0 to 3.0 mils.

e. Total DFT 4.0 to 6.0 mils

f. Finish Color: As selected by Owner from manufacturer's standard colors

D. Coating Systems For Porous Concrete Masonry Units And Concrete

1. Interior Exposed:

a. System Type: Epoxy.

b. Surface Preparation:

1. Porous Concrete Masonry Units: SSPC-SP 13/NACE 6. Clean and dry.

2. Concrete: SSPC-SP 13/NACE 6. Abrasive blast.

c. Primer: Series 54-660 Masonry Filler. Spreading rate 75 to 100 sq ft/gal.

d. Intermediate Coat: Series 66 Hi-Build Epoxoline. DFT 4.0 to 6.0 mils.

e. Finish Coat: [Series 66 Hi-Build Epoxoline. DFT 4.0 to 6.0 mils.

f. Total DFT: 8.0 to 12.0 mils plus filler.

g. Finish Color: As selected by Owner from manufacturer's standard colors

E. Coating Systems For Plaster And Gypsum Board

1. Interior Exposed:

a. System Type: Vinyl-acrylic/acrylic-epoxy.

b. Surface Preparation: Clean and dry.

c. Primer: Series 51-792 PVA Sealer. DFT 1.0 to 2.0 mils.

d. Finish Coat: Series 113 H.B. Tneme-Tufcoat. DFT 4.0 to 6.0 mils.

e. Total DFT: 5.0 to 8.0 mils.

f. Finish Color: As selected by Owner from manufacturer's standard colors

F Coating Systems For Wood

1. Interior or Exterior Exposed:

a. System Type: Alkyd/acrylic-epoxy.

b. Surface Preparation: Clean and dry.

c. Primer: Series 36 Undercoater, DFT 2.0 to 3.5 mils.

d. Finish Coat: Series 113 H.B. Tneme-Tufcoat. DFT 4.0 to 6.0 mils.

e. Total DFT: 6.0 to 9.5 mils.

f. Finish Color: As selected by Owner from manufacturer's standard colors

2.05 ACCESSORIES

A. Coating Application Accessories:

1. Accessories required for application of specified coatings in accordance with manufacturer's instructions, including thinners.

2. Products of coating manufacturer.

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. Workmanship: Unless otherwise specified, all paint materials shall be applied by brush or roller in strict accordance with the manufacturer's printed instructions. SPRAY PAINTING IS NOT ALLOWED WITHOUT SPECIFIC APPROVAL IN EACH CASE. Each coat shall be applied at proper consistence, and shall be free of brush or roller marks, sags, runs or any other evidence of poor workmanship. The splattering of paint on glass, hardware, tile, trim, and other surfaces not to be painted shall be avoided. Masking tape shall be applied as required. The Contractor shall sand between all enamel coats.

B. Coverage Rates: In no case shall paint application exceed the paint manufacturer's published coverage rate based upon unthinned material. In the event that paint has been extended beyond the recommended coverage, or the "hide" produced is inadequate, as determined by the Engineer, the Contractor shall apply one or more additional coats as determined by the Engineer at no additional cost to the OWNER. The manufacturer's recommended amount of thinner shall not be exceeded. Unless otherwise approved, finish coat material shall be applied as taken from manufacturer's container.

C. Protection: Floors, fixtures, equipment, and similar surfaces shall be protected with impervious protective covers and/or drop cloths.

D. Removal of Finish Hardware: Finish hardware shall be removed prior to painting and finishing and re-installed as specified in Section [06200] "Finish Carpentry and Millwork."

E. Contrasting Colors: Where painting is to be executed in contrasting colors, edges shall be cut to meet true lines. Holidays and restrikes in painted surfaces shall be sufficient cause for necessitating recoating the entire surface involved. More than one color may be used in any one room.

F. Barricades: The Contractor shall maintain barricades and wet paint signs for duration of period needed.

G. Scaffolds: The Contractor shall provide and transfer scaffolds, staging, and planking as necessary for proper performance of work.

3.02 PREPARATION

A. General: The Contractor shall properly prepare surfaces to receive finishes as indicated and specified.

B. Surface Preparation Of Steel

1. Prepare steel surfaces in accordance with manufacturer's instructions.

2. Fabrication Defects:

a. Correct steel and fabrication defects revealed by surface preparation.

b. Remove weld spatter and slag.

c. Round sharp edges and corners of welds to a smooth contour.

d. Smooth weld undercuts and recesses.

e. Grind down porous welds to pinhole-free metal.

f. Remove weld flux from surface.

3. Ensure surfaces are dry.

4. Immersion or Below Grade Surfaces: Remove visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter in accordance with SSPC-SP 10/NACE 2.

5. Exterior Exposed or Interior Exposed Surfaces: Remove visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter in accordance with SSPC-SP 6/NACE 3.

6. Interior or Immersion Surfaces, Severe Exposure: Remove visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter in accordance with SSPC-SP 5/NACE 1.

7. Marginally Prepared Surfaces (Maintenance): Remove visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter in accordance with manufacturer's instructions.

8. Abrasive Blast-Cleaned Surfaces: Coat abrasive blast-cleaned surfaces with primer before visible rust forms on surface. Do not leave blast-cleaned surfaces uncoated for more than 8 hours.

9. Shop Primer: Prepare shop primer to receive field coat in accordance with manufacturer's instructions.

C. Surface Preparation Of Galvanized Steel And Nonferrous Metal

1. Prepare galvanized steel and nonferrous metal surfaces in accordance with manufacturer's instructions.

2. Surface preparation recommendations will vary depending on substrate and exposure conditions.

3. Ensure surfaces are dry.

4. Immersion Service: Clean surfaces by abrasive blasting.

5. Remove Rust From Galvanized Steel:

   a. Remove white rust from galvanized steel by hand or power brushing.

   b. Remove rust from old galvanized steel in accordance with SSPC-SP 2 or SP 3.

   c. Do not damage or remove galvanizing.

6. Increase mechanical adhesion under moderate to severe conditions, such as exterior exposure or chemical environments, by abrasive blast and/or chemical cleaning.

D Surface Preparation Of Concrete

1. Prepare concrete surfaces in accordance with manufacturer's instructions, SSPC-SP 13/NACE 6, and ICRI 03732.

2. Allow concrete to cure for a minimum of 14 days.

3. Test concrete for moisture in accordance with ASTM D 4263 and F 1869.

4. Level concrete protrusions and mortar spatter.

5. Fill hairline cracks less than 1/64 inch (0.4 mm) in accordance with manufacturer's instructions.

6. Prepare cracks wider than 1/64 inch (0.4 mm), moving cracks, gaps, and expansion joints in accordance with manufacturer's instructions.

7. Ensure surfaces are clean, dry, and free of oil, grease, chalk, form release agents, and other contaminants.

E. Surface Preparation Of Concrete Floors

1. Prepare concrete surfaces in accordance with manufacturer's instructions, SSPC-SP 13/NACE 6, and ICRI 03732.

2. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.

3. Allow concrete to cure for a minimum of 28 days before coating.

4. Test concrete for moisture in accordance with ASTM D 4263 and F 1869.

F Surface Preparation Of Porous Concrete Masonry Units

1. Prepare porous concrete masonry unit surfaces in accordance with manufacturer's instructions and SSPC-SP 13/NACE 6.
2. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.
3. Allow mortar to cure for a minimum of 28 days before coating.
4. Level protrusions and mortar spatter.

G. Surface Preparation Of Gypsum Board

1. Prepare gypsum board surfaces in accordance with manufacturer's instructions.
2. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.
3. Sand joint compound smooth and feather edge.
4. Avoid heavy sanding of adjacent gypsum board surfaces, which will raise nap of paper covering.
5. Do not apply putty, patching pencils, caulking, or masking tape to drywall surfaces to be painted.
6. Lightly scuff-sand tape joints after priming to remove raised paper nap. Do not sand through primer.

H Surface Preparation Of Wood

1. Prepare wood surfaces in accordance with manufacturer's instructions.
2. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, surface deposits of sap or pitch, and other contaminants.
3. Painted surfaces shall be sanded smooth and dusted clean. Nail holes, cracks, or other defects shall be carefully puttied after prime coat using putty that matches the color of the paint. Knots and sappy areas shall be covered with shellac or accepted knot sealer.
4. Putty work shall be knifed as specified; thumb puttying is not allowed. On painted and enameled work, exposed end grain shall be putty-glazed smooth and flush, and shall be allowed to dry before the next coat.
5. Lightly sand between coats.

3.03 APPLICATION

A. General: Paint shall not be applied in extreme heat, nor in dust or smoke laden air, nor in damp or humid weather.

B. Drying times shall be not less than called for in manufacturer's printed instructions.

C. Drop cloths shall be placed where required to protect floors and equipment from splatter and droppings.

D. Spray painting, where allowed, shall be conducted under controlled conditions, and the Contractor shall be fully responsible for any damage to adjacent work or adjoining property occurring from spray painting.

E. Each coat will be inspected by the Engineer prior to application of the next coat. Areas found to contain runs, overspray, roughness, or other signs of improper application shall be required to be recoated in accordance with the Engineer's instructions.

F. Drying time shall be in accordance with the manufacturer's printed recommendations.

G. The Contractor shall apply complete paint system required for exposed surfaces behind permanent cabinets, cases, counters, and similar work before such items are installed.

H. Woodwork: Woodwork shall be sanded smooth and knots and pitch streaks shall be painted with a thick coat of orange shellac or a resin sealer, except for stained wood. Nail holes and minor imperfections shall be filled with putty between first and second coat; color of putty shall match stain in the case of stained work.

I. Stained or Natural Woodwork: Putty shall be colored to match the stain or wood of the appurtenant woodwork.

J. Backpainting: Prior to installation, back surfaces of wood trim and finish that will be concealed after installation, including trims, exposed grounds, and paneling shall be painted. On painted and enameled work, the Contractor shall use the same primer as for exposed surfaces. Work to receive a natural finish shall be backpainted with one coat of spar varnish. Backpainting shall be omitted on casework and cabinets that are completely factory finished under other sections.

K. Coats and Colors: The number of coats specified to be applied are minimums only. Paint finishes shall be even, of uniform color, and free from cloudy or mottled appearance in surfaces and evident thinness of coatings. Each coat shall be tinted a sufficiently different shade of finish color to permit identification, in accordance with accepted samples.

3.04 OUTLINE OF PAINTING AND FINISHING WORK

A. Exterior: In general, all exposed exterior surfaces of the building shall be painted and finished in accordance with the requirements herein specified for paint materials and surfaces. Exposed surfaces of miscellaneous metal, sheet metal items, mechanical equipment, and all other items, as required, shall be painted with the required primers and coats of paint.

B. Interior: In general, exposed surfaces of the building shall be painted and finished in accordance with the requirements herein specified for paint and finish materials and surface:

1. Exposed surfaces of gypsum wallboard, plaster, and doors and frames, shall be primed and painted as specified.

2. Metal items in partitions and ceilings such as registers, grilles, and similar items shall be painted to match finish of room or area in which they occur, unless directed otherwise by the Engineer.

3. Painted doors opening into rooms or spaces having different finishes or colors shall have the edges finished as directed by the Engineer. Closet and storage room doors shall be finished on both sides to match the room into which they open.

C. Mechanical and Electrical Work: Mechanical and electrical products requiring painting shall conform to the requirements of Section 09960 "Protective Coating" except for the following:

1. Areas behind grilles, baffles, ventilators, and louvers: exposed surfaces, not factory finished, visible from inside and outside of the building shall be painted with appropriate primers and one coat of black semi-gloss (low sheen) enamel paint far enough to conceal such areas and spaces when looking towards them from the floor and ground levels.

2. Pipe Identification: Piping shall be identified by means of stencils of various sizes to suit size of pipes and by flow arrows. Piping shall be stenciled with letters and flow arrows at each point of entry or exit to a room or space, at junctions of piping, and in long runs at intervals not exceeding 20 feet. Stencils shall correspond with pipe abbreviations shown on mechanical drawings.

3.04 REPAIR

A. Materials and Surfaces Not Scheduled To Be Coated: Repair or replace damaged materials and surfaces not scheduled to be coated.

B. Damaged Coatings: Touch-up or repair damaged coatings. Touch-up of minor damage shall be acceptable where result is not visibly different from adjacent surfaces. Recoat entire surface where touch-up result is visibly different, either in sheen, texture, or color.

C. Coating Defects: Repair in accordance with manufacturer’s instructions coatings that exhibit film characteristics or defects that would adversely affect performance or appearance of coating systems.

3.05 ADJUSTMENT AND CLEANING

A. General: The Contractor shall make a detailed inspection of paint finishes after painting work has been completed, and shall carefully remove splattering of paint material from adjoining work of others (particularly plumbing fixtures, trim, tile, and finish metal surfaces), and shall make good any damage thereto that may be caused by such cleaning operations. The Contractor shall carefully touch-up all abraded, stained, or otherwise disfigured painting work and shall leave the entire painting work in first-class condition.

B. Clean-up and Disposal: During and upon completion of work, the Contractor shall remove unused tools and equipment, surplus materials, rubbish, debris, dust and shall leave areas affected by work of this section in clean approved condition in accordance with the requirements of the GENERAL REQUIREMENTS.

3.06 ONE-YEAR INSPECTION

A. Owner will set date for one-year inspection of coating systems.

B. Inspection shall be attended by Owner, Contractor, Engineer, and manufacturer's representative.

C. Repair deficiencies in coating systems as determined by Engineer in accordance with manufacturers instructions.

3.07 SCHEDULES

A. Coating Schedule:

1. Exterior pre-cast concrete below grade
2. Exterior cast-in-place below grade
3. Effluent Flume (interior)
4. UV Chamber (interior)
5. Exterior metal doors and frames
6. Interior metal doors & frames
7. Interior Masonry Walls
8. Exterior Woodwork
9. Interior Woodwork
10. Concrete Floors
11. Interior Gypsum Board Walls

B. Color Schedule

1. Building Exteriors:

a.	Exposed wood other than redwood	Owner selected
b.	Aluminum gutters, downspouts and flashing	Owner selected
c.	Bollards	Safety yellow
d.	Doors and frames	Owner selected
e.	Aluminum access doors and frames	Unfinished
f.	Overhead doors and frames	Owner selected
g.	Louvers, vents, grills, etc.	Owner selected

2. Building Interior:

a.	Doors and frames	Owner selected
b.	Walls and ceilings	Owner selected
c.	Miscellaneous equipment and surfaces	Owner selected

END OF SECTION

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SECTION 09960

PROTECTIVE COATINGS

PART 1 GENERAL

1.01 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

B. Where standards of surface preparation are described by citing SSPC specification numbers reference is made to the "Steel Structures Painting Manual" Volume 2 published by the Steel Structures Painting Council.

American Society of Testing and Materials (ASTM)

ASTM D4060	Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
ASTM D2794	Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D4541	Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
ASTM F1249	Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor

1.02 DESCRIPTION

A. Section Includes:

1. All exposed metal and steel pipes and mechanical equipment except for the following:

   a. Items painted under Section 09905.

   b. Pumps

   c. Sprinkler heads

   d. Stainless steel, louvers

   e. Fire extinguishers, emergency shower and similar items

   f. Rubber

   g. Plastic pipes, including: polyvinyl chloride, polyethylene, and polypropylene piping and similar items

   h. Nameplates and grease fittings

i. Pre-finished or anodized aluminum

B. The Contractor is to base this bid on using the products specified. If the products specified are not available in formulations that meet applicable regulations on volatile organic compounds (VOC) levels at time of application, the Contractor is to submit for review products of equivalent quality and function that comply with regulations in effect at that time. A reasonable difference in cost of material between the first named items specified and the products that are required to meet regulations that change after the bid date and are in effect at the time of application may be approved for payment by Change Order.

1.03 DEFINITIONS

A. Dry Film Thickness (DFT) - The prime coat and the sum of all fully cured applied coats for the paint system.

B. Exterior Surface - Surface that is not inside a building or structure and is exposed to the weather.

C. Stripe Coat - Coating applied to the edge, corner, welds or bolts that is applied prior to application of additional system coats.

D. Submerged - Surfaces that are under water or the vertical extension of those walls that are partly under water during normal operating conditions.

1.04 SUBMITTALS

A. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

1. Storage and Handling

a. Provide Material Safety Data Sheets (MSDS's) for all products.

2. Materials

a. Prior to ordering material, submit a complete schedule of materials to be used. Include manufacturer's brand name, product name, and designation number for each coat of each system to be used.

b. Paint Products.

Provide the following information on each paint product:

1) Abrasion resistance, ASTM D4060, 1 kg load at 1000 cycles, CS-17 wheel.

2) Impact resistance, ASTM D2794, direct and reverse.

3) Moisture vapor transmission, ASTM F1249.

4) Adhesion, ASTM D4541.

If materials other than those listed are submitted, submit additional information to fully define the proposed substitution. The Engineer may further require the Contractor to furnish additional test results from an independent paint laboratory comparing the proposed substitution with one of the named products, at no additional cost to the Owner. For substituted materials, provide a list of references, including contact person and phone number, where proposed substitute paint system has been used in similar exposures. Provide a minimum of five references (no duplicate owners or agencies).

3. Certificates

a. Manufacturer's Certification

That products furnished meet applicable Air Quality Management District regulations as to allowable volatile organic compound (VOC) content for the place of application and use intended.

4. Samples

a. Label/Stenciling Samples; Color Code Charts

1) Submit a full range of the manufacturer's standard and let down finish colors for review and selection by the Engineer. After final colors have been selected, submit two 8 ½" x 11-inch samples on cardboard of each color indexed as to manufacturer and color designation. Color chips ¾-inch x 1 ½ inch may be used for pipe color codes.

2) Submit four pipe and equipment color code charts, 11 x 14 inches in size, with typed labels and using color chips. Upon favorable review, frame charts and mount under glass, suitable for hanging in work areas.

1.05 QUALITY ASSURANCE

A. Environmental Regulatory Requirements:

1. All work, material, procedures, and practices under this Section shall conform to requirements of the local Air Resources Board or Air Quality Management District having jurisdiction. Prime or finish coat painting done in locations other than the project site shall be in accordance with air quality regulations in effect at the place the coating is applied. Products specified herein are, to the best of the Engineer's knowledge, in compliance with the applicable volatile organic compounds (VOC, measured in grams per liter by weight of coating as applied, excluding water and color added to be base tint) levels allowable at the date these Specifications were issued for bid.

2. The Air Resources Board or Air Quality Management District having jurisdiction may prohibit the sale or application of paints and enamels containing more than the stipulated percentages of volatile organic solvents manufactured after a stated date. Provide material meeting applicable regulations effective at the date of manufacture, or if not available, provide top of the line materials developed as replacements for specified materials and meeting applicable regulations as to VOC solvents content.

3. If the Contractor applies coatings that have been modified or thinned other than as recommended by manufacturer, he will be responsible for any fines, costs, remedies or legal actions that may result.

1.06 WARNINGS

A. Be advised that application of paint, epoxy and protective coating materials may be hazardous. Take all necessary precautions to ensure the safety of workers and property.

B. Be advised that as a part of this work abrasive blasting is required. This may require the use of special equipment. Become familiar with the existing site conditions and take all steps necessary to protect adjacent facilities and personnel, at no additional cost to the Owner. In addition, abrasive blasting and painting is called for in, on or around mechanical equipment, which may be damaged by grit, dust, or painting overspray. Mask, wrap, enclose and provide all protection required to safeguard this equipment at no additional cost to the Owner.

C. Perform abrasive blasting activities in a manner that will not cause a nuisance to adjacent property and equipment.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver all coating materials in unopened containers with manufacturer's label, which must include name, batch number and date and VOC content.

B. Store in an assigned area onsite with concurrence from the coating manufacturers. Maintain storage area clean and fire safe. Dispose of used rags, thinner and buckets daily. Store solvents in closed approved storage containers.

C. Submerge solvent soaked rags in water.

1.08 PROJECT CONDITIONS

A. Environmental Requirements:

1. Provide ambient temperatures recommended by manufacturer of material to be applied.

2. Provide adequate ventilation.

3. Provide 40- to 50-foot candles of illumination on all surfaces in areas to be painted including floors, walls and ceiling even though they do not require painting.

4. Use temporary dust barriers to close off areas being painted from areas where other work is being performed.

1.09 COLORS AND SAMPLES

A. Before starting work, obtain favorably reviewed color schedule.

B. Colors are to be factory mixed, using light-fast colorants proportioned by accurate measurement into proper type base. All coatings must be formulated to perform in the climate and environment to which they will be exposed.

PART 2 PRODUCTS

2.01 MATERIALS

A. Materials used in each system shall be the product of one manufacturer.

B. Shop applied prime coats shall be compatible with the systems included in these specifications.

C. Substituted coating systems shall be of the same generic type as those specified.

D. Coating systems shall not contain lead.

E. Materials: Paints and protective coatings listed in the Paint Systems and the Schedule in 2.02 of this Section refer to the following manufacturers and are specified as levels of quality. It is understood that the words "or equal" are included herein.

- Sherwin Williams (SW)
- Kop Coat (K)
- Tnemec Co. (T)
- Roto Metals (RG)
- Protecto Wrap (PW)
- Tapecoat (TC)
- Chemical Products Co. (ZRC)
- Ameron (A)
- Thermecoat-Welco (TW)
- CRC Industries (CRC)

2.02 COATING SYSTEMS

System 1: General Ferrous Exposed to Atmosphere

1st Coat - bare metal	High Solids Epoxy	(A) Amerlock 400
		(T) Series 135
Finish Coat(s)	High Solids Epoxy	(A) Amerlock 400
Total DFT = 12 mils		(T) Series 135
Final coat for exterior surfaces	Aliphatic Polyurethane	(A) Amercoat 450HS
DFT = 2 mils additional		(T) Series 74

System 2: Galvanized Metal Surface Repair

One Coat:		
To be left unpainted:	Eutectic-type repair	(TW) Gal-Viz
		(RG) ReGalv
To be painted:	High zinc content	(ZRC) Cold Galv. Compound
DFT = 2 mils		(CRC) Zinc It

System 3: Submerged Ferrous Metal (Potable Water)

Two coats	High Solids Epoxy	(A) Amerlock 400
DFT = 12 mils		(T) Series 140, Pota-Pox Plus

System 4: Bleeding Surfaces: (Not buried)

1st Coat(s)	High Solids Epoxy	(A) Amerlock 400
		(T) Series 135
2nd Coat	High Solids Epoxy	(A) Amerlock 400
DFT = 12 mils		(T) Series 69
Finish coat – exposed surfaces	Aliphatic Polyurethane	(A) Amercoat 450HS
DFT = 2 mils additional		(T) Series 74

System 5: Prefinished Machinery Coating (Other than prime coat)

One coat	Aliphatic Polyurethane	(A) Amershield
DFT = 2 mils		(T) Series 74

System 6: Galvanized Steel and Non-Ferrous Metals

1st Coat(s)	High Solids Epoxy	(A) Amerlock 400
		(T) Series 135
2nd Coat	High Solids Epoxy	(A) Amerlock 400
DFT = 8 mils		(T) Series 69
Finish coat – exposed surfaces	Aliphatic Polyurethane	(A) Amercoat 450HS
DFT = 2 mils additional		(T) Series 74

System 7: Miscellaneous Service Coating

One full brush coat	Coal Tar	(K) Bituplastic #33
		(T) 46-40 Tnemecol

System 8: Buried Valves

One full brush coat		(PW) 160/160 H Mastic
DFT = 20 - 30 mils		(TC) TC Masti

System 9: Fiberglass

1st Coat(s) (Tie Coat)	Aliphatic Polyurethane	(A) Amercoat 185
		(T) Series P66
Finish coat – exposed surfaces	Aliphatic Polyurethane	(A) Amershield
DFT = 2 mils additional		(T) Series 73

PART 3 EXECUTION

3.01 SURFACE PREPARATION

A. Prepare surfaces in strict accordance with manufacturer's instructions prior to application. Provide manufacturer's instructions with submittal. Apply first coat immediately after surface preparation. Keep all paints at a consistency and applied in accordance with the printed directions of the manufacturer. The painting shall be done by hand, spray or roller as approved by the manufacturer and Engineering conformance to individual paint manufacturer's recommendations. The Engineer and paint supplier will review all surfaces to be painted on the job prior to application of any coatings. Once the Contractor begins undercoating or priming, this will be his guarantee that the surface is acceptable to paint. All painted surfaces are to be free from drips, ridges and brush marks. The following stipulations also apply:

1. Thinning permitted only when recommended by the manufacturer and only with thinner recommended for use with the particular product.

2. The use of additives to improve working characteristics or to lengthen or shorten set time is prohibited.

3. Items difficult or impossible to paint after installation are to be painted before installation and touched up after installation.

4. Apply each coat to a uniform, even coating; lay material on in one direction and finish at right angles. Allow material to thoroughly dry between coats. Scuff, sand and remove all runs, sags, overspray, surface roughness and other defects between each coat. Dust and wipe surface clean before applying next coat.

5. Cutting in is to be sharp and straight, free from overlaps or fuzzy edges. Redo any imperfect work.

6. Apply not less than the number of coats or dry film thickness specified. Apply additional coats if required for uniform coverage, full hiding, and to achieve film continuity. Finished work to be uniform in color, full coverage, smooth and free of sags and brush marks.

7. Do not apply coating when temperature is below 55°F or when the temperature of the surface to be painted is less than 4°F over the dew point temperature. Perform coating operations only under favorable environmental conditions. Take all steps necessary to protect and completely cure the work. Correct defective work to the full satisfaction of the Engineer.

8. Apply the last finish coat on all work after all major construction is complete and the work areas have been cleaned up and are dust free.

3.02 PIPE AND EQUIPMENT IDENTIFICATION

A. Identify all piping and equipment exposed to the atmosphere, both interior and exterior, and including pipe located in concrete pipe trenches, by a combination of color coding, stenciling or pressure-sensitive tape and direction arrows.

B. Identify painted pipe 4 inches in diameter and larger by stenciling identification names and directional arrows. Identify unpainted pipe and pipe less than 4 inches in diameter by color vinyl pressure-sensitive lettered labels and arrows. Place names and arrows every 16 feet and wherever a pipe enters or leaves a room or a pipe trench. Provide lettering size as follows:

Pipe Diameter	Lettering Size* (Height)
1 ¼" or less	½"
1 ½" to 2"	¾"
2 ½" to 6"	1 ¼"
8" to 10"	2"

Over 10”	3 ½”

* All lettering shall be in capital. Submit font type for approval.

C. Provide pipe identification names as listed in the Piping Schedule; the Engineer will abbreviate any names exceeding 20 letters. Directional arrows are to be in black and be proportional to lettering. Color of equipment and pipe shall be as shown on a schedule to be provided by the Engineer. Gloss enamel is to be used for stenciling.

D. Piping Color Schedule (submit samples):

Pipeline	Color
Sewage	Green
Potable Water	Medium Blue
Treated Effluent	Light Green
Sludge	Dark Brown

E. Paint equipment in the same color as the pipe to which it is connected.

F. Paint conduit and ductwork in colors to match adjacent walls/ceilings.

3.03 CLEANING AND COMPLETION

A. At the completion of this portion of the work, remove all debris, remove all paint and stains from work for which paint finish is not intended, touchup all marred surfaces, and leave all buildings and structures in a clean condition, ready for use.

B. Refinish all damaged or imperfect painting to the satisfaction of the Engineer prior to final acceptance of the facility.

C. Finish work, except waterproofing mastics, is to present an even, pleasing and uniform color and appearance. Surfaces exhibiting coatings with shadows, streaks, overlap marks, sags, drips, roughness or non-uniform sheen will be considered as improperly applied and will not be considered acceptable.

D. Leave all machinery nameplate data tags clean and readable and all grease fittings clean and usable.

3.04 SPARE PAINT

A. Provide a complete blending formula to develop each color used on the project.

3.05 APPLICATION SCHEDULE

Provide coatings in accordance with the following exposure schedule:

Exposure	Surface Preparation	Paint System	Notes (see below)
General ferrous exposed to atmosphere	Bare Metal: Sandblast Shop Primed: Hand Tool Cleaned	1	1
Galvanized metal surface repair	Hand Tool Cleaning	2	2
Submerged ferrous metal	Abrasive blast except solvent clean galvanized items	3	3
Bleeding surface	Solvent Clean per paint manufacturer's recommendations	4	4
Exposed galvanized steel, copper and other non- ferrous metals	Solvent clean, lightly hand sand, and pre-wash	5	5
Prefinished machinery coating	Hand tool cleaning	6	6
Vent pipes exposed at building roofs and metal mounted in contact with walls	Hand tool cleaning	7	7
Buried valves, flanges, etc.	Solvent Clean and Hand Tool Cleaning	8	8
Factory finish coated items not requiring field painting	Touchup		9
Engine Exhaust Brush Clean	Brush Clean		10

Notes to Application Schedule:

1. These surfaces include, but are not limited to: general miscellaneous ferrous metal; machinery; pumps; blowers; compressors; supports; valve handwheels and stands; valve bodies; piping systems; structural steel; steel elements; except where other systems in this schedule are more specifically applicable.

2. Use galvanize-repair paint to repair-galvanize surfaces to be painted. Use eutectic-type repair to repair-glvanize surfaces to remain unpainted.

3. Apply this system to both ferrous metal and galvanized metal submerged in or suspended over water or sludge. These surfaces include but are not limited to machinery parts, piping, valves, brackets and supports, and miscellaneous supports, braces, and pump columns. Do not blast clean galvanized surfaces; instead provide one prime coat of 40 passivator prior to finish painting. Coat inaccessible surfaces prior to erection.

4. All items furnished with asphalt or coal tar (bleeding) epoxy shop coats, which would otherwise be covered by System 1.

5. All piping, valves, pumps, drives, machinery, and equipment that have factory finish coats that will be exposed to atmosphere. This system provides for repair of above named items and color uniformity with rest of field coat items.

6. Exposed metal electric conduit, exposed copper pipe and other non-ferrous metal items.

7. All cast iron soil pipe and associated flashing above the building roof. Also coat metal items, which are surface, mounted on exterior, basement or gallery masonry walls, plaster walls and concrete surfaces. Coat such metal items only on the contact surfaces unless otherwise specified; specifically include electrical panels, control cabinets, fixtures and guardrail support brackets.

8. Buried steel and cast-iron valves, operators, steel flanges, and other buried ferrous metals.

9. All panels and equipment with factory finishes identified elsewhere as not requiring field paint, damaged during shipping, storage, or installation: touch-up in the field in a manner compatible with the factory coating with respect to paint type, color, and texture. Touch-up fusion epoxy-coated items only with material provided by the fusion epoxy fabricator. If more than 5% of the surface requires touchup, return the items to the fabricator for recoating.

10. Exterior surfaces of engine exhaust, rain hood and rain cap where these items are above the roofline.

END OF SECTION

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DIVISION 10

SPECIALITIES

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DIVISION 11

EQUIPMENT

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SECTION 11600

LABORATORY FURNISHINGS AND EQUIPMENT – WASTEWATER

PART 1 GENERAL

1.01 WORK INCLUDED

A. Furnish and install laboratory equipment.

1.02 SUBMITTALS

A. Submit shop drawings of all equipment specified in this section in accordance with Section 01300, SUBMITTALS.

PART 2 PRODUCTS

2.01 PRODUCT SCOPE

A. The Wastewater Treatment Plant laboratory is designed to perform the following tests required by the NPDES permit that are normally done by the Township in-house.

2.02 MANUFACTURER'S

A. Acceptable manufacturers for laboratory and furnishings include:

1. Hach
2. Thomas Scientific
3. Fisher Scientific
4. Grainger
5. USA Bluebook

B. Manufacturers listed for each item have been specified as a reference standard.

C. The items listed in Section 2.03, "Laboratory Equipment" is given as a minimum requirement. The testing equipment will be dictated by the monitoring requirements of the permit.

2.03 LABORATORY EQUIPMENT

A. The following equipment and supplies list shows typical items and their quantities:

Description	Cat No.	Quantity
Combination shower eyewash (Blue Book)	42570	1
Latest Edition of Standard Methods (Blue Book)	43544	1
MSDS (For each chemical)	Standard	1

Description	Cat No.	Quantity
Calculator (Fisher)	12-099	1
Electric Wall Clock (Fisher)	06-664-5	1
First Aid Cabinet (Fisher)	10-020	1
Scissors (Fisher)	14-275C	1
Wastebasket (Grainger)	3U633	1
Soap dispenser (Grainger)	2U411	2
Soap (Grainger)	3U526	1 case of 12
Paper towel dispenser (Grainger)	4CJ95	2
Paper towels (Grainger)	4CJ76	2 case of 6
Hearing Protection (Grainger)	6AJ15	2
Step Stool (Grainger)		1
Life Preserver Ring (McMaster-Carr)	5509T9	Varies

PART 3 EXECUTION

3.01 EXECUTION

A. Contractor shall install all equipment and furnishings indicated on the Contract Drawings.

END OF SECTION

SECTION 11601

LABORATORY FURNISHINGS AND EQUIPMENT - WATER

PART 1 GENERAL

1.01 WORK INCLUDED

A. Furnish and install laboratory equipment.

1.02 SUBMITTALS

A. Submit shop drawings of all equipment specified in this section in accordance with Section 01300, SUBMITTALS.

PART 2 PRODUCTS

2.01 PRODUCT SCOPE

A. The Water Treatment Plant laboratory is designed to perform the operational tests and analyses required by the operating permit that are normally done by the Township in-house.

2.02 MANUFACTURER'S

A. Acceptable manufacturers for laboratory and furnishings include:

1. Hach
2. Thomas Scientific
3. Fisher Scientific
4. Grainger
5. USA Bluebook

B. Manufacturers listed for each item have been specified as a reference standard.

C. The items listed in Section 2.03, "Laboratory Equipment" is given as a minimum requirement. The testing equipment will be dictated by the monitoring requirements of the permit.

2.03 LABORATORY EQUIPMENT

A. The following equipment and supplies list shows typical items and their quantities:

Description	Cat No.	Quantity
Combination shower eyewash (Blue Book)	42570	1
Safety Goggles (Hach)	20972-00	1
MSDS (For each chemical)	Standard	1

Description	Cat No.	Quantity
LaMotte Chlorine Colorimeter Lab	L367001LI	1
Above w/ optional AC Adapter	L1726-110	1
Selection of Glass Beakers and Flasks	various	10
Orion 310 pH meter complete	O031000	1
PH 4, 7 and 10 buffers 1 gallon	JSG 4, 7 and 10	3
Assortment of Glass beakers 100 to 500 ml	varies	10
Magnetic Stirrer (Hanna Instruments Inc)	H190MU	1
Magnetic Stirring Bar Set (Hanna Instruments Inc)	HI731319	10
Magnetic Stirring Bar retriever (Fisher)	14-513-69	1
Calculator (Fisher)	12-099	1
Electric Wall Clock (Fisher)	06-664-5	1
First Aid Cabinet (Fisher)	10-020	1
KimWipes case of 12 (280 ct)	KW155-12	1
Combination Storage Cabinets (Grainger)	4W539	2
Wastebasket (Grainger)	3U633	1
Soap dispenser (Grainger)	2U411	2
Soap (Grainger)	3U526	1 case of 12
Paper towel dispenser (Grainger)	4CJ95	2
Paper towels (Grainger)	4CJ76	2 case of 6
Hearing Protection (Grainger)	6AJ15	2
Step Stool (Grainger)		1

PART 3 EXECUTION

3.01 EXECUTION

A. Contractor shall install all equipment and furnishings indicated on the Contract Drawings.

END OF SECTION

DIVISION 13

SPECIAL CONSTRUCTION

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SECTION 13110

PUMP STATION LEVEL CONTROLS

PART I GENERAL

1.01 WORK INCLUDED

A. The Contractor shall furnish and install Pump Station Level Controls and accessories as specified herein and as indicated on the Drawings.

B. The manufacturer of the level control system shall be responsible for the proper design of the system. All equipment shall perform as specified and the completed installation shall operate in accordance with the requirements of the Drawings and Specifications for this project.

C. Unless pre-approved by Engineer, all components shall be by the same manufacturer.

1.02 SYSTEM DESCRIPTION

A. The level control system includes the equipment required to automatically start and stop the influent pumps as well as monitor alarm conditions detrimental to the pump station operation. The system includes the following:

1. Electrical components required interfacing with the motor starters for the pump motors.

2. Equipment to measure the wet well level and control the wet well level by controlling the starting and stopping of the pumps.

3. Interface with the autodialer to transmit pump status and alarm conditions to the system operator.

B. Operation of the pump station shall be as follows:

1. Automatic Sequence: All possible combinations of all three influent pumps as lead, lag and standby pump.

2. Fixed Sequence: One pump is designated as lead, one pump is designated as lag and one pump is designated as standby. Manual switching will be required to change the sequence.

3. An independent high level alarm and redundant control system shall be provided in case of the primary system failing.

1.03 SUBMITTALS

A. Submit under the provisions of Section 01300.

B. Shop Drawings: Indicate in large scale detail, fabricated equipment showing construction methods and locations in plan and cross section, mounting requirements and clearances, and utility requirements as to types, sizes and locations. For control system, indicate service connections, characteristics and wiring diagrams.

C. Product Data: Provide equipment dimensions and construction, equipment capacities, characteristics and limitations, materials, finishes, utility requirements and locations.

D. Manufacturer's Installation Instructions: Indicate installation requirements and special procedures.

1.04 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 01730.

B. Operation Data: Provide operating data for specified equipment.

C. Maintenance Data: Provide periodic maintenance requirements and schedules.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with Section 01400.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle equipment according to manufacturer's instructions and the provisions of Section 01600.

1.07 SCHEDULING AND COORDINATION

A. Schedule work under the provisions of Section 01300.

B. Coordinate the delivery and installation of the work of this section with the work of other sections.

1.08 WARRANTY

A. The manufacturer shall provide a warranty against any defect or malfunction due to workmanship in the equipment and accessories for a period of one year from date the system is put into service.

B. A written manufacturer's warranty shall be supplied.

1.09 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 01725.

B. Record actual locations of pipes, utilities, equipment and accessories.

1.10 MANUFACTURER'S REPRESENTATIVE

A. Furnish the services of a qualified equipment manufacturer's representative for one 8-hour day or longer if necessary after equipment installation for testing, instruction, and correction of deficiencies.

PART 2 PRODUCTS

2.01 SUBMERSIBLE LEVEL PROBE

A. Probe Materials

1. Sensors: Avesta 254 SMO High Grade Stainless Steel Alloy.
2. Probe Casing: uPVC Premium Quality Extruded Tube
3. Cable: PVC/PVC Multi core.

B. Probe Dimensions

1. Dimensions: Diameter: 1 1/4"
2. Length: 60"
3. Mounting: Via the supplied Multitrode suspension/cleaning bracketinside the wet well.

C. Temperature Range

1. Working Temperature °F: 0° to 150°

D. Model No 1.0/10 30 as manufactured by Multitrode or approved equal.

2.02 CONTROLLER

A. Description

The pump controller shall be a Multitrode type MT2PC or equivalent capable of automatically alternating up to nine pumps when networked with other controllers units. Each controller shall monitor and control two pumps and three alarms and be capable of discriminating between four different fault conditions. The unit shall be capable of expansion with the simple addition of further control units. This will allow from 2 pumps to be controlled. The unit shall be communications ready and all data and functions will be accessible via its coms port.

B. Mounting

1. The unit shall have the ability to be DIN rail mounted or panel mounted.
2. The keypad shall be detachable and capable of being remotely mounted on the front panel.

C. Keypad

1. The following controls shall be provided on the keypads:

   a. Hand/Off/Auto operation for each pump.

   b. Resetting of faults for each pump.

   c. The setting of a fixed Lead pump or an alternating pump sequence.

   d. Resetting of level alarms.

   e. Some of the keypads shall have a dual purpose to allow for the programming of the controller.

D. Indication

1. LEDS shall be provided for the purpose of indication.

2. A bar graph shall be provided to indicate level.

3. A separate LED shall be provided for each of the following functions per pump.

Pump running	Green
Pump set to manual mode	Green
Pump set to the off mode	Red
Pump set to the automatic mode	Green
Pump available	Amber
Fault	Red
Critical fault	Red
Delay fail fault	Red
Seal fault	Red
Program Switch set to on	Amber
Alternation selected	Amber
Three sequence LED's shall be provided in order to determine pump sequence.	See owner
Two level alarm LED's	Red
Miscellaneous LED's shall be provided for the purpose of programming the unit.	See owner

E. Level Sensing

1. The unit shall accept a 10-stage multi sensored conductive probe
2. The unit will monitor sensor inputs and will indicate any irregular inputs.
3. The unit shall accept a 4-20mA analog level signal.
4. In the event that an analog signal is used for level measurement, the unit must switch back to the multi sensored probe upon failure of, or erratic input from, the 4-20mA analog level signals.

F. Programming

1. The pump activation and deactivation points shall be selectable from the switchboard keypad. (Entry to the wet area will be unacceptable for changing levels.)
2. Pump Alternating: The unit shall be able to lead select or automatically alternate some or all of the pumps. There shall be two selectable groups of pumps, where either can be set to alternate or fixed lead. The groups shall be either normal operation or lag group on/lead off. Next pump to start will be indicated.
3. Fail Safe Manual Override: When in manual pump operation, the unit will automatically return the mode from manual to auto once the normal input out level is reached. Ability to temporarily override this function will be provided.
4. Temporary Reset of Level Alarms: The unit shall be capable of temporarily disabling level alarm outputs.
5. Maximum Pump Starts: The device shall be capable of limiting the number so starts per hour for each pump are at an acceptable level.
6. Random Duty Start Level: The start delay for the pumps shall be capable of being randomly set over a selectable range of delays.
7. Security: Two levels of access will be provided to the front keypad.
8. Maximum Number of Pumps: Maximum number of pumps to run simultaneously shall be selectable.
9. Pump Disable: For triplex controllers, the unit should have the ability to totally de-commission the third pump by deactivating the controls and indication, if required.
10. Blocked Pumps: These should be able to be monitored and, if necessary lock ineffective pumps out it blockage does not clear after a pre selected number of tries.

11. Auto Level Adjustment: Should station starts per hour exceed a selectable number, then the duty level shall automatically increase. A maximum level (selectable) will not be exceeded. Time delays will prevent two pumps from operating together unnecessarily.

12. Peak Management: The unit shall be able to store two independent sets of level set points for all pump and alarms, which can be selected via a simple, digital, input signal.

G. Time Delays

1. Time delays for pump and alarm activation and deactivation should be available. These time delays will be selectable from the front keypad for the activation and deactivation of level set points.

2. Interpump Delay: The interpump delay shall be provided to allow selection of a delay to prevent any pump changing status within a certain period of another pump starting or stopping (except in the case of a fault).

3. Maximum Pump Off Time: The unit shall be capable of automatically turning a pump on should a selectable maximum off time for that pump be reached.

4. Maximum Pump On Time: The unit shall be capable of turning any pump off and force a cycle should a selectable maximum on time be reached.

H. Fault Monitoring

1. The unit will monitor the following fault conditions via n/o or n/c inputs:

   a. Non-Critical: Unit will temporarily disable pump and indicate.

   b. Critical: Unit will permanently lock out pump until manually reset.

   c. Seal: Adjustable seal detection shall be provided to either indicate or lock pump out on detection of seal failure.

   d. Delay Fail: The unit will provide a delay fail input, settable up to 160 seconds to enable the pumps to operate before monitoring of this input occurs. This fault shall either lock the pump out or temporarily disable it. This input may be used for flow detection.

2. The unit will be able to monitor the pumps seal and thermal inputs and carry out appropriate functions and displays.

3. The unit shall be capable of temporarily disabling level alarm outputs.

I. Communication

1. RS232 and RS422/RS485 communication links will be provided for down loading all logged data, and for telemetry.

2. All settings, parameters and controls will be fully accessible via the communication port or front keypad.

3. The units will be capable of being networked on an RS485 twisted pair link in such a manner that:

   a. A number of groups of units and/or pump controller on different pits/tanks can be controlled and monitored fully.

   b. These units will be capable of interfacing to a telemetry system using a single two-way radio and/or modem.

J. Miscellaneous

1. Power Supply. The unit shall be powered by 110VAC, 10-30V DC or both simultaneously where redundancy is required.

2. DC Supply. In this mode, the unit should monitor mains supply using an external relay, so that safety delays are maintained during power restoration.

3. Transient Protection. The unit shall have built in transient protection.

4. Removable Terminals. The controller will have plug in terminals to simplify exchange.

5. Intrinsically Safe. The unit should be able to be easily upgraded to I.S., if required in the future.

6. Fail Safe Manual Override. When manual pump operation, the unit will automatically return the mode from manual to auto once the normal pump cutout level is reached. Ability to temporarily override this function will be provided.

7. Pulse Pump On. The unit will be able to prematurely activate the next pump to start via a simple, digital, pulsed input.

8. Multi Pump (4 to 9 Pumps). The unit will be able to be expanded to control 4 9 pumps by connecting another of the same unit using the RS485 communications port.

9. Commissioning. On commissioning, the water level shall be capable of being simulated on the keypad in order that correct functioning of the system can be determined.

2.03 SYSTEM MONITOR

A. Description

1. The unit shall monitor, control, display and log functions of the connected MT2PC pump controller, as well as all events listed within this specification.

2. A user-friendly interface will enable all configurations, programming, setting and display of controls and all functions without the need of a laptop computer or other device.

3. The unit shall also be programmable via a laptop computer where required.

B. Mounting

1. The unit shall have the ability to be DIN rail mounted or panel mounted.

2. The keypad shall be capable of being remotely mounted on the front panel.

C. Keypad

1. The unit will be able to be:

   a. Panel mounted

   b. DIN rail mounted, with the keypad remotely mounted on the front panel.

   c. Durable, water and dust resistant.

D. Display

1. A 40 character 4 line LCD display will indicate all starts, events and settings, including:

   a. Pump status for up to three pumps

   b. Electrical current per phase for up to four pumps

   c. Most recent number of pump starts per hour for each pump

   d. Supply volts for each phase

   e. Hours run: total and last run for each pump

   f. Duration of high level and flood level alarms

   g. Total volume pumped

   h. Individual pumps volume and flow rate

   i. Status of all faults

   j . Rainfall

   k. All faults will be user configurable and user definable.

   l. Date and Time will be displayed and updated via communications or user inputs on keypad.

E. Current Monitoring

1. The unit will continually monitor and protect each pump for the following:

    a. Over current for all phases for each pump

    b. Under current for all phases for each pump

    c. Automatically carry out a 500V insulation test on each motor and log results

F. Voltage Monitoring

1. Phase failure for each pump

2. Phase rotation for each pump

3. AC supply voltage

4. DC supply voltage

5. All parameter settings above must be capable of being selectively displayed and adjusted from front keypad, as well as communication port.

G. Other Inputs

1. The unit will accept, in addition, the following user configurable and user definable inputs and outputs:

    a. 6 digital inputs

    b. 2 analog inputs (4 20mA)

    c. 3 digital outputs (Dry Contact)

    d. 1 analog output

2. Analog inputs will have programmable set points

3. All inputs and outputs can be assigned to carry out functions to both the MonitorPro and connected pump controller.

F. Flow

1. Volume and Flow: The unit will calculate volume and flow and update continuously, allowing for inflow, variations in pit diameter, and multiple pumps operating simultaneously.

2. Flow Displays and Flags: The unit will continually display volume and flow rates for each pump, total volume for pit, and new pump rate for each pump. A flag indicating selectable low flow rate input will warn of pump inefficiency or blockage.

3. Flow Calibration: The unit will automatically and continuously update and calibrate flow rates for all pumps once a single volumetric input is entered.

G. Communications

1. Communication: RS232 and RS422/RS485 communication links will be provided for down loading all logged data, and for telemetry.

2. All settings, parameters and controls will be fully accessible via the communication port or front keypad.

3. The units will be capable of being networked on an RS485 twisted pair link in such a manner that:

   a. A number of groups of units and/or pump controller on different pits/tanks can be controlled and monitored fully.

   b. These units will be capable of interfacing to a telemetry system using a single two-way radio and/or modem.

4. Data Logging: All events or user-selected events will be time stamped and stored indefinitely.

5. Data Storage: The unit will be able to store at least 512K of data.

   a. When data storage is near full, the display will advise, as well as notification via communication port.

   b. When data log is full, oldest data will be erased to make room for new, current data.

6. Data Retrieval: All events will be displayed and scrolled via the local display, or be down loaded to laptop or via telemetry or phone line.

7. Radio Modem: The unit will be able to directly control and communicate with a 2-way radio for future telemetry.

8. Phone Modem: The unit will interface to a standard telephone modem, if required via its RS232 comport.

9. Date and Time: Will be displayed and updated via communications or user inputs on keypad.

10. Help Functions: When connected, via the RS485 com port, to a Multitrode MT2PC or MT3PC controller, help displays will be shown when setting parameters, etc. on the controller.

11. Store and Forward: The unit will be capable of forwarding messages and data between another site, using another of the same unit and the CMF. In this case, the unit should still be capable of performing all other functions related to its own site.

H. Miscellaneous

1. The unit will be powered by 30VDC, 240VAC or both, when back up is required.

2. The unit will have plug in terminal connections for easy removal.

I. The unit shall be a Monitor Pro as manufactured by Multitrode or approved equal,

2.04 ENCLOSURES

A. The equipment shall be mounted in a wall mounted, NEMA 12 stainless steel enclosure with front door. All hardware and hinges shall be stainless steel. Chassis plates shall be .125 " grade 6061 -T6 aluminum, Transformers above I KVA and similar items shall be mounted on struts.

B. The enclosure shall have all operator controls, indicators, breakers and resets mounted on the outer door. The enclosure shall be properly vented and equipped with fans and heaters as needed to keep internal temperature below 80^{o} F and above 32^{o} F or as otherwise required by OEM.

2.05 TELEPHONE DIALER

A. A RACO Verbatim auto phone dialer unit shall be provided which will automatically call predetermined telephone numbers when any alarm condition is indicated at the alarm annunciation panel. The unit shall transmit a programmed message stating nature of the alarm condition. If the called number is busy, does not answer or if an incorrect number is reached, the unit shall hang up and call up to eight back-up numbers. Once the call is received, the person receiving it can acknowledge the unit from his telephone so that it will hang up and not place any more calls.

B. The unit shall monitor up to eight sets of normally open contacts, which can activate telephone numbers and voice message. Channel shall have built in AC monitoring circuitry so that if the AC power is lost to the station, the unit will automatically call out. There shall be a bypass switch so that this function can be bypassed and Channel used for other external alarms.

C. The unit shall have an adjustable (0-90 seconds) time delay to allow time for the operator to respond to the alarm. A rechargeable battery unit shall be included to notify of AC power loss. The battery shall have sufficient capacity to supply six hours of calling after AC power failure.

D. Electrical:

1. Power Requirement 105-135 VAC, 15 watts maximum.

2. Standby Battery: Gel Cell 6V, 2.6 A.H. Standby time 6 hours.

3. Battery Charging: Precision voltage controlled, including automatic rapid recharge after drain.

4. Input Sensing: Alarm on open contacts is standard, but each channel may be independently keyboard programmed for alarm on closed contacts or no alarm.

5. Surge Protection: Heavy duty gas tubes followed by solid state surge/transient protection on all inputs.

E. Dialing Format

1. Standard rotary pulse. FCC registered. Dials up to 8 different numbers.

2. Done by pressing a Touch Tone "9" during alarm call, or by calling dialer back after alarm call is completed.

F. Program and Diagnostic Readout

1. Pressing a Touch Tone "O" during any call causes user entered keyboard programming to be spoken over the phone.

2.06 REDUNDANT HIGH ALARM/PUMP CONTROL SPECIFICATION

A. An independent high level and low level alarm and redundant control capability with features as hereinafter listed shall be provided in addition to the specified primary control system. It shall be powered by a dedicated 120 VAC circuit breaker and use three direct-acting level-responsive float switches as described.

B. The independent alarm/control panel equipment shall be designed to UL508 Industrial Control Panel standards and shall incorporate a 120 VAC input transformer with transient protection, a fused primary and a DC power supply with limited 12 VDC to supply the level sensing float circuit(s). The control shall be by float switches arranged in the wet well, two switches shall be at higher elevations than the normal operating range of the primary control and alarm. The float switches shall be mounted in the wet pit in accordance with manufacturers instructions.

C. Upon the occurrence of a high level condition sensed by the redundant system, the wet well level shall be maintained by the back-up direct acting float switches and control circuits. These control circuits shall be wired in parallel with the primary control system two wire control circuits to provide a redundant capability. As the level recedes from the high level float, the alarm contact shall return to its normal state; however, the redundant control contacts are to continue to operate until the system is manually reset. The third float switch shall be set to turn off all pumps if wet well level falls below a predetermined level and transmit a low water level alarm.

D. The redundant control/alarm capability shall be completely integrated in the specified control panel and system as described and in accordance with all applicable codes and job requirements.

2.07 REDUNDANT LIQUID LEVEL SENSORS AND MOUNT SPECIFICATION

A. The level detecting device shall be a 5 1/2" diameter type 316 stainless steel float switch with a mercury switch inside and flexibly supported by a PVC jacketed, heavy duty cable. The float shall be mounted on a vertical 1" S.S. pipe as shown on the plans. It shall be installed in accordance with the manufacturer's recommendations.

B. The float switch shall have a 10 Amp rating at 115 vac and 8 Amps at 230 vac. The float shall be type SO with three 18 AWG fine-stranded copper conductors. The float shall be mounted to the 1" pipe using type 316 stainless steel hardware.

C. The Float Switch shall be furnished in quantities and with such accessories as are required to perform the specified control and alarm functions for this application. The float switch shall be ROTO-FLOAT as manufactured by Healy-Ruff, Saint Paul, Minnesota or approved equal. It shall have a 3-year factory warranty.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that site conditions are ready to receive the work of this section.

B. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

A. Install the equipment in accordance with Drawings and manufacturer's instructions.

3.03 DEMONSTRATION

A. Test and calibrate equipment to ensure proper working order of all components.

B. At completion of work, provide qualified personnel to demonstrate operation and instruct owner in operating procedures and maintenance.

END OF SECTION

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DIVISION 15

MECHANICAL

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SECTION 15000

PIPING, GENERAL

PART 1 GENERAL

1.01 SCOPE

A. It shall be the responsibility of the Contractor to furnish and install all piping systems. Each system shall be installed complete with all applicable fittings, hangers, supports, anchors, expansion joints, flexible connections, valves, and accessories to provide a functional system as designed. In addition, all insulation, lining and coating, heat tracing, testing, disinfection, excavation, backfill and encasement shall be the responsibility of the Contractor.

B. The Contractor shall provide all tools, equipment, materials, and supplies necessary and shall perform all labor necessary to complete the work. The Contractor shall provide all testing apparatus necessary to perform testing as required by these specifications. The Contractor shall provide any equipment necessary for inspection of and testing of piping systems specified.

C. The term “piping” is intended to define the general layout, configuration, and routing, required method of support, pipe size and type only. It is the responsibility of the Contractor to provide a complete system in accordance with relevant contract drawings and requirements. All details necessary to provide a complete system are the responsibility of the Contractor. The Contractor shall provide all spools, spacers, adapters, connectors, and supports necessary to provide a complete and functional system. The Contractor shall furnish pipe supports, hangers, anchors, etc., when necessary, to provide a completely functional system as specified herein. The Contractor shall provide layout drawings of all piping systems prior to installation showing all piping, equipment, accessories, supports, etc.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Comply with the reference specifications of the GENERAL REQUIREMENTS.

B. Commercial Standards:

ANSI/ASME B1.20.1	Pipe Threads, General Purpose (inch)
ANSI B1 6.5	Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and other Special Alloys
ANSI/AWWA C207	Steel Pipe Flanges for Water Works Service, Sizes 4 in through 144 in
ANSI/AWWA C606	Grooved and Shouldered Joints
ANSI/AWS D1.1	Structural Welding Code

ASTM A 307	Specification for Carbon Steel Bolts and Studs, 6,000 psi Tensile
ASTM A 325	Specification for High-Strength Bolts for Structural Steel Joints
ASTM D 792	Test Methods for Specific Gravity and Density of Plastics by Displacement
ASTM D 2000	Classification System for Rubber Products in Automotive Applications

1.03 SUBMITTALS

A. The Contractor shall complete shop drawings of all piping systems, equipment, accessories, and supports in accordance with the provisions of Section 01300

B. The shop drawings shall include all necessary dimensions and details on pipe joints, fittings, fitting specials, valves, appurtenances, design calculations, and material lists. The submittals shall include detailed layout, spool, or fabrication drawings which show all pipe spools, spacers, adapters, connectors, fittings, and pipe supports necessary to accommodate the equipment and valves provided in a complete and functional system. The Contractor shall submit detailed layout drawings of all systems for approval prior to starting installation. Layout drawings shall include all dimensions and spacings for pipe joints, fittings, fitting specials, valves, appurtenances, connectors, adapters, supports, hangers, anchors, etc. necessary to provide a complete and functional system as specified herein.

C. The Contractor shall submit as part of the shop drawings a statement from the pipe fabricator certifying that all pipes will be fabricated subject to a recognized Quality Control Program.

1.04 QUALITY ASSURANCE

A. Material Testing: The Engineer shall have the right at any time to call for and witness the making of test specimens by any welder in accordance with these specifications. Any and all tests shall be at the Contractors expense. The Contractor shall furnish the Engineer 3 (three) certified copies of mill test reports. Mill test reports shall show results of the chemical and physical tests made on each melt of steel representing the steel plate furnished for the manufacture of the pipe.

B. Welding Procedures: Welding procedure specifications shall be furnished to the Engineer for approval prior to the welding of pipe. The specifications shall specify, on a form equivalent to the ASME welding procedure form, the type of plate edge preparation, welding method, arc-voltage, arc-amperes, travel speed, wire size and type, flux type, and all other procedures necessary to make the weld.

C. Welder Qualifications: All welders and welding operators shall be qualified under the applicable provisions of the standard qualification procedure of the ASME Boiler and Pressure Vessel Code, Section IX.

1.05 MANUFACTURER'S SERVICE REPRESENTATIVE

A. Where the assistance of a manufacturer's service representative is advisable, in order to obtain perfect pipe joints, supports, or special connections, the Contractor shall furnish such assistance at no additional cost to the Owner.

1.06 MATERIAL DELIVERY, STORAGE, AND PROTECTION

A. All piping materials, fittings, valves, and accessories shall be delivered in a clean and undamaged condition and stored off the ground with all ends capped, to provide protection against oxidation caused by ground contact or vermin infestation. All defective or damaged materials shall be replaced with new materials.

1.07 CLEANUP

A. After completion of the work, all remaining pipe cuttings, joining and wrapping materials, and other scattered debris, shall be removed from the site. The entire piping system shall be handed over in a clean and functional condition.

PART 2 PRODUCTS

2.1 GENERAL

A. All pipes, fittings, and appurtenances shall be furnished in accordance with the requirements of the applicable Sections of Divisions 02, 11 and 15 and as specified herein.

B. Pipe and valve sizes are nominal inside diameter unless otherwise noted.

C. Construct vents of materials specified for the pipe system for which they serve.

D. All materials delivered to the job site shall be new, free from defects, and marked to identify the material, class, and other appropriate data such as thickness for piping.

F. Acceptance of materials shall be subject to strength and quality testing in addition to inspection of the completed product. Acceptance of installed piping systems shall be based on inspection and leakage tests as specified hereinafter.

G. Cutoff Flanges: Provide at all pipe penetrations for pipes 4 inches and greater in nominal diameter, and at all penetrations of 3-inch and smaller nominal diameter pipe in wet or potentially wet locations as indicated on the Drawings. Cutoff flange outside diameter shall be at least a standard connection flange's outside diameter. Cutoff flange shall be at least ¼-inch thick and shall be continuously welded (or cast) onto the pipe.

H. Pipe Supports: All pipes shall be adequately supported in accordance with the requirements of Section 15140, PIPE SUPPORTS, and as shown.

G. Fasteners: Whenever stainless steel bolts are specified, it shall mean that all bolts, nuts and washers shall be made of type 316 stainless steel, unless otherwise noted.

2.02 PIPE SCHEDULE

A. Pipe and Fitting Designation: Piping systems are identified by an "Identifier" designation in these Specifications. The Piping Schedule designation identifies not only the identifier, type of pipe but also the specifications associated with the system. The Identifier is also used on the drawings and throughout the specifications to indicate things like test procedures and pressure described for that system.

B. Pipe Schedule: Pipe material, joints and fittings shall be as summarized below. A detailed specification of each pipe type follows is included in its associated specifications. (The detailed specification supersedes the schedule in case of any conflicts.)

System	Designator	Pipe Material	Design Pressure	Specification
Air	A	DIP	15 psig	15005
Compressor Air	ACP	Copper	125 psig	11262
Cold Water	CW	Copper	125 psig	15400
Drain	D	PVC	10 psig	15400
Digested Sludge	DSL	DIP	50 psig	15005
Ferric Chloride	FEC	PVC	150 psig	This Specification
Hot Water	HW	Copper	125 psig	15400
Non-Potable Water	NPW	Copper	125 psig	11263
Odor Control	OD	Fiberglass	15 psig	13260
Plant Effluent	PLW	DIP	Gravity	15005
Plant Sanitary Sewer	PS	DIP	Gravity	15005
Potable Water	PW	Copper	125 psig	15400
Raw Wastewater	RW	DIP	50 psig	15005
Secondary Effluent	SE	DIP	50 psig	15005
Sodium Hypochlorite	SHC	PVC	150 psig	This specifications
Sludge	SL	S.S.	25 psig	This Specification
Sodium Hydroxide	SHX	PVC	150 psig	This specifications

Storm Sewer	SS	ADS	Gravity	02630
Vacuum Air	VAC	Copper	28” H.G.	11262
Vent	V	PVC	10 psig	15400

2.03 PIPE FLANGES

A. Flanges: Where the design pressure is 150 psi or less, flanges shall conform to either ANSI/AWWA C207 Class D or ANSI 1316.5 150-Ib class. Where the design pressure is greater than 150 psi, up to a maximum of 275 psi, flanges shall conform to ANSI/AWWA C207 Class E, Class F, or ANSI 1316.5 150-Ib class. Where the design pressure is greater than 275 psi up to a maximum of 700 psi, flanges shall conform to ANSI 1316.5 300-Ib class. Flanges shall have flat faces and shall be attached with boltholes straddling the vertical axis of the pipe unless otherwise shown. Attachment of the flanges to the pipe shall conform to the applicable requirements of ANSI/AWWA C207. Flanges for miscellaneous small pipes shall be in accordance with the standards specified for these pipes.

B. Blind Flanges: Blind flanges shall be in accordance with ANSI/AWWA C207, or with the standards for miscellaneous small pipes. All blind flanges for pipe sizes 12inches and larger shall be provided with welded or screwed eye bolts.

C. Flange Coating: All machined faces of metal blind flanges and pipe flanges shall be coated with a temporary rust-inhibitive coating to protect the metal until the installation is completed.

D. Flange Bolts: All shall conform to ASTM A193; AISI Type 304 Stainless Steel, ANSI B18.2.1. Bolts shall be of such length that after installation, bolts will project 1 /8 to 3/8 inch beyond the fact of the nut. No "all-thread" studs will be allowed. Flange Nuts: All shall conform to ASTM A194, AISI Type 304 Stainless Steel, ANSI B18.2.2, and heavy hex pattern.

E. Insulating Flanges: Insulating flanges shall be used for joining flanged piping of dissimilar metals and for piping systems where corrosion or cathodic protection are involved. Insulated flanges shall have boltholes ¼-inch diameter greater than the bolt diameter.

F. Insulating Flange Sets: Insulating flange sets shall be provided where shown and where necessary to prevent contact between dissimilar metals. Each insulating flange set shall consist of an insulating gasket, insulating sleeves and washers and a steel washer. Insulating sleeves and washers shall be one piece when flange bolt diameter is 1-1 /2 inch or smaller and shall be made of acetyl resin. For bolt diameters larger than 1-1 /2 inch, insulating sleeves and washers shall be 2-piece and shall be made of polyethylene or phenolic. Steel washers shall be in accordance with ASTM A 325. Insulating gaskets shall be full-face.

G. Insulating Flange Manufacturers, or approved equal:

1. JM Red Devil, Type E;

2. Maloney Pipeline Products Co., Houston;

3. PSI Products, Inc., Burbank, California.

H. Flange Gaskets: Gaskets for flanged joints shall be full-faced, 1 /16 inch thick compressed sheets of aramid fiber base, with nitrite binder and non-stick coating, suitable for temperatures to 700 degrees F, a pH of one to eleven, and pressures to 1000 psig. Blind flanges shall have gaskets covering the entire inside face of the blind flange and shall be cemented to the blind flange. Ring gaskets shall not be permitted:

Water Service: Gaskets shall be ASTM D1330, GRADE I, red rubber with 1 /8 inch minimum thickness and dimensions to suit contact facing.

Oil Service: Gaskets shall be ANSI 1316.21, non-asbestos filler with neoprene or nitrile binder, 1/16-inch minimum thickness for plain finished surfaces and 3/32-inch minimum thickness for serrated surfaces.

Flat Face Flanges: Gaskets shall be ANSI B1 6.21, non-asbestos filler with neoprene or nitrite binder, 1/16-inch minimum thickness for plain finished surfaces and 3/32-inch minimum thickness for serrated surfaces.

Raised Face Flanges: Gaskets shall be continuous Stainless Steel ribbon wound into a spiral with non-asbestos filler between adjacent coils with a carbon steel gage ring. Compressed gasket thickness shall be 0.0095 inch -/+0.005 inch.

I. All flanges are subject to inspection and testing at the discretion of the Engineer.

K. Flange Gasket Manufacturers, or approved equal:

1. John Crane, style 2160;

2. Garlock, style 3000.

2.05 THREADED INSULATING CONNECTIONS

A. General: Threaded insulating bushings, unions, or couplings, as appropriate, shall be used for joining threaded pipes of dissimilar metals and for piping systems where corrosion control or cathodic protection are involved.

B. Materials: Threaded insulating connections shall be of nylon, Teflon, polycarbonate, polyethylene, or other nonconductive materials, and shall have ratings and properties to suit the service and loading conditions.

2.06 SLEEVE-TYPE COUPLINGS

A. Construction: Sleeve-type couplings shall be of steel construction with steel bolts, and of sizes to fit the pipe and fittings. The middle ring shall be not less than 1 /4 inch in thickness and 5 or 7-inches long for standard couplings, and 16-inches long for long-sleeve couplings. The followers shall be single-piece contoured mill section welded and cold expanded to fit for the middle rings. They shall be of sufficient strength to accommodate the number of bolts necessary to obtain adequate gasket pressures

without excessive rolling. The shape of the follower shall be designed as to provide positive confinement of the gasket. Bolts and nuts shall be Type 316 Stainless Steel in buried locations and heat-treated Grade 5 or better for above ground piping and gallery piping inside structures. Buried sleeve-type couplings shall be factory-applied epoxy-coated.

B. Pipe Preparation: The ends of the pipe shall be prepared to fit steel couplings. Plain ends for use with couplings shall be smooth and round for a distance of 12-inches from the ends of the pipe, with outside diameter not more than 1 /64-inch smaller than the nominal outside diameter of the pipe.

C. Gaskets: Gaskets for sleeve-type couplings shall be rubber-compound material that will not deteriorate from age or exposure to air under normal storage or use conditions. Gaskets for wastewater and sewerage applications shall be Buna "N," Grade 60, or equivalent suitable elastomer. The rubber in the gasket shall meet the following specifications:

1. Color - Jet Black
2. Surface – Non-blooming
3. Durometer Hardness - 74 ± 5
4. Tensile Strength - 1000-psi minimum
5. Elongation - 175 percent minimum

The gaskets shall be immune to attack by impurities normally found in water or wastewater. All gaskets shall meet the requirements of ASTM D 2000, AA709Z, meeting Suffix B13 Grade 3, except as noted above. All gaskets shall be compatible with the piping service and fluid utilized.

D. Insulating Couplings: Where insulating couplings are required, both ends of the coupling shall have a wedge-shaped gasket which assembles over a rubber sleeve of an insulating compound in order to obtain complete insulation of all coupling metal parts from the pipe.

E. Restrained Joints: Restrained joints for sleeve-type couplings shall be in accordance with AWWA M-11.

F. Manufacturers, or approved equal:

1. Dresser, Style 38;
2. Ford Meter Box Co., Inc., Style FC1 or FC3;
3. Smith-Blair, Style 411.

2.07 FLEXIBLE CONNECTORS

A. Flexible connectors shall be installed in all piping connections to engines, blowers, compressors, and other vibrating equipment, and where shown. Flexible connectors shall be flanged, braided stainless steel spools with inner, annular, corrugated stainless steel hose, rated for minimum 150 psi working pressure, unless otherwise shown. The connectors shall be minimum of 9-inches long, face-to-face flanges, unless otherwise shown. The Contractor shall submit manufacturer's shop drawings and calculations.

2.08 EXPANSION JOINTS

A. All piping subject to expansion and contraction shall be provided with expansion joints to compensate for movement, without exertion of undue forces to equipment or structures. Expansion joints shall be of stainless steel, monel, rubber, or other materials, suitable for each individual service. The Contractor shall submit detailed calculations and manufacturer's shop drawings and information on materials, temperature and pressure ratings.

2.09 PIPE THREADS

A. All pipe threads shall be in accordance with ANSI/ASME B1.20.

2.10 PIPE INSULATION

A. Hot and cold liquid piping, flues, and engine exhaust piping shall be insulated as shown. Pipe insulation shall be in accordance with Section 15250, "Pipe and Equipment Insulation".

2.11 AIR TRAPS

A. Compressed air pipes shall be installed with continuous slope towards the low points. Drip legs shall be provided with shut-off valves, strainers and traps. The traps shall be piped to the nearest drain. Air traps shall be not less than 150-lb iron body float type with copper or stainless steel float suitable for the service. Bracket, lever, and pins shall be of stainless steel. Drain traps shall have threaded connections.

B. Manufacturers, or Equal:

1. Armstrong Machine Works;

2. Spirax Sarco, Inc.

2.12 PIPE SLEEVES

A. Where specified or as indicated on the contract drawings, pipe sleeves shall be provided for piping passing through concrete or, masonry walls.

B. Pipe sleeves shall be Type 316L stainless steel with a welded water-stop ring.

2.13 PLASTIC CHEMICAL PIPING

A The primary carrier piping for the various chemical systems shall consist of the following materials:

Line	Systems		
	Ferric Chloride	Sodium Hydroxide	Sodium Hypochlorite
Pipe	PVC	PVC	PVC

B. All chemical piping shall be installed so that lines are readily accessible for cleaning.

C. At all exposed changes in direction in chemical piping, tees shall be provided with extra threaded openings plugged to facilitate cleaning.

1 Thread tape or thread sealer shall be applied to the threads of all plugs to facilitate ease of removal.

2.14 DOUBLE CONTAINMENT FOR PLASTIC CHEMICAL PIPING

A. Secondary Containment shall be used for all chemical systems outside of the diked chemical storage areas.

B. Double containment shall consist of an assembled inner-centered pipe within a secondary outer pipe, fabricated by adhesive joining or butt fusion, or a co-extruded one-piece double containment pipe.

C. The assembled double-containment system secondary pipe shall be constructed of poly vinyl chloride (PVC) or polypropylene (PP) pipe for outdoors applications. These systems shall be joined to provide a minimum of 150 psig at 73° F leak free seals. The outer piping shall be painted in accordance with Section 09960, Protective Coatings and Section 151900, Mechanical Identification Systems.

1 All assembled double-containment piping and fittings shall be supplied by the same source to insure material and system compatibility. The carrier and containment pipe and fittings shall be Schedule 80 X Schedule 40 and shall be factory assembled with centralizing and anchoring devices installed.

D. The co-extruded one-piece double containment pipe system shall conform to the following:

1. Material: Pipe, and fittings shall be manufactured from Type II Copolymer, polypropylene material as described in ASTM D 4101. Pipe and fittings manufactured from the BE 50 Resin will not be acceptable under any circumstances.

2. Pipe and Fittings - Construction: Pipe shall be co-extruded one-piece double containment pipe. The primary pipe shall be integral with the secondary pipe via connecting ribs, which are continuous down the entire length of each section of

pipe. Fittings shall be a molded unitary double wall fitting. Permanent alignment of the inner and outer fittings shall be maintained via molded-in ribs. Piping and fittings components shall be manufactured to SDR dimensions.

3. Pressure Rating: Pipe and fittings shall be rated for 150 PSI in all sizes and materials at 73 degrees F.

4. Factory Welded Joints: Factory joints shall be either made by butt fusion or extrusion welding. Joining by means of solvent cement, and fillet welding is prohibited.

5. Site Joints: site joints shall be made utilizing butt fusion only.

6. Installation: Installation shall be in accordance with the drawings, the manufacturer's recommendations. The entire installation shall be installed in proper alignment and free of stress. Sufficient stainless steel leaders shall be such that all mains and branches can beprovided with a leak detection system.

7. Testing: The system shall be tested in accordance with the manufacturer's recommendations.

E. Secondary containment shall be provided with 3/4 inchschedule 80 plastic pipe at low points and field routed to the nearest diked containment and/or sump which would be compatible to accept the chemical being discharged.

2.15 STAINLESS STEEL PIPE

A. Stainless steel pipe shall be 304 or 304L seamless or welded pipe meeting ASTM A312 or MIL-P-1144. Pipe 3/4 inch and smaller shall be Schedule 80 with threaded ends. Fittings shall have a minimum burst pressure of 3000 psi.

2.16 FLOOR BOXES

A. Manufacture and Design: The floor boxes shall be designed for installation in concrete floors and slabs to provide support for extension stems of non rising and covering for the operating nut on the valve stem.

B. Acceptable manufactures for the Floor Boxes are:

1. F-5690 manufactured by Clow

2. A-27010 manufactured by Muller Co.

3. Style 1108 manufactured by M&H Co.

4. Approved equal.

2.17 SLUDGE SHOES

A. Manufacture and Design: The cast iron sludge shoes shall be designed for installation on flanged pipe with a flare to reduce entrance losses.

B. Acceptable manufactures for the Floor Boxes are:

1. Sludge Shoe manufactured by Clow

2. Sludge Shoe manufactured by Tyler Pipe Co.

2. Sludge Shoe manufactured by Star Pipe Products.

4. Approved Equal.

PART 3 EXECUTION

3.01 GENERAL

A. All piping and appurtenances shall be installed in accordance with the requirements of all applicable and related Divisions of these specifications.

B. Any deviation from lines, grades, or elevations shown on the Contract Drawings must be approved in writing by the Engineer.

3.02 HANDLING

A. All pipe, fittings, and related appurtenances shall be handled in a manner that will insure installation in sound, undamaged, sanitary, like new condition.

B. Pipe and fittings with cement mortar or epoxy lining or special coatings shall handled with rubber covered hooks, or other type of equipment to prevent damage.

C. Bare forklift arms, hooks, cables, or chains shall not be used for handling pipe with special lining or coating.

D. Pipe and fittings in which the lining or coating has been damaged shall be immediately removed from the job site and replaced.

1. In instances where damage is minimal, the Contractor may, with approval from the Engineer, have the damage repaired by a qualified representative of the pipe manufacturer or fabricator.

3.03 STORAGE

A. All pipe shall be stored off the ground at all times, even during installation with caps on all openings.

B. Store coated pipe on "extra wide" skids to protect the coating.

C. PVC pipe shall be stored out of direct sunlight to prevent damage and premature deterioration.

D. Pipe with special coatings shall be stored out of direct sunlight to prevent damage to coating.

E. Copper and galvanized pipe shall be covered or stored indoors.

F. Threaded ends of pipe shall be covered to protect the threads.

G Flanged pipe shall have the flange faces protected.

H. Pipe that has become damaged or unidentifiable due to improper storage shall be rejected and immediately removed from the job site.

3.04 CUTTING PIPE

A. Cutting of pipe shall be done in a neat manner, without damage to the pipe, pipe lining, or pipe coating.

B. Cuts shall be smooth, straight, and at right angles to the pipe axis.

C. Pipe shall be cut using a portable guillotine saw, abrasive wheel "cut-off" saw, or milling cutter only. Use of gas torches for cutting pipe will not be permitted.

1. Where it becomes necessary to cut steel pipe larger than 6" in diameter, the Contractor may, with written permission of the Engineer, use gas torch to cut the pipe.

2 Only a qualified pipe fitter shall make any approved torch cuts of pipe.

D. Field cut holes for saddles shall be made utilizing a hole saw or other mechanical means. Gas torch cutting of holes will not be permitted.

E. After cutting, the end of the pipe shall be dressed with a file or power grinder to remove all internal and external burrs and sharp edges.

F. All damaged or removed lining or a qualified representative of the pipe manufacturer or fabricator shall repair coating.

3.05 CLEANING

A. The interior of all pipe and fittings shall be thoroughly cleaned of all foreign matter prior to installation, and shall be kept clean until the work has been accepted.

B. Before jointing, all joint contact surfaces shall be wire brushed, wiped clean, and kept clean until the jointing is completed.

C. Flange faces shall be wire brushed and cleaned to remove all oil, grease, loose primer, mill scale, or any other foreign matter, which could affect the proper seating of the gasket.

D. Prior to testing, pipe shall be thoroughly cleaned and/or purged in accordance with these specifications.

3.06 PIPE SLEEVES

A. Unless otherwise specified or indicated on the contract drawings, pipes passing through concrete or masonry shall be installed through Type 316 stainless steel sleeves installed before concrete is placed or masonry is laid.

B. The Contractor shall be responsible for coordinating the installation of sleeves for all piping.

C. Pipe sleeves installed through floors provided with a special finish, such as ceramic tile, resilient tile, or seamless flooring, shall be flush with the finished floor surface, and shall be provided with nickel or chromium plated floor plates.

D. In all other locations where pipes pass through floors, pipe sleeves shall project 2" above the finished floor surface, with the projection uniform throughout each floor area.

E. In the case of insulated pipes, the insulation shall be carried through the pipe sleeve.

F. Where it is indicated on contract drawings to provide for future installation of pipe, sleeves shall be provided and the ends sealed with an approved plastic cap/plug.

G. For piping passing through existing concrete or masonry floors or walls, core drilled holes will be accepted when approved in writing by the Engineer.

H. All pipes passing through interior concrete or masonry walls or slabs shall be caulked on both sides with approved caulking.

I. All pipes passing through walls or slabs, which have one side, exposed to the outside, have one side in contact with earth, or have one side exposed to a water bearing or water conveying structure, shall be sealed watertight by the use of modular casing seals ("link-seals") and be caulked on both sides of the wall or slab.

3.07 PIPE INSTALLATION

A. All piping shall be installed as specified and in a manner acceptable to the Engineer.

B. Each piece of pipe and each fitting shall be carefully inspected to see that there is no defective workmanship on pipe, or obstructions in pipes and fittings.

C. The Contractor shall provide pipe cut from measurements made at the job site, and not from the contract drawings.

D. Provisions shall be made in laying out all piping throughout to provide for expansion and contraction. Anchor piping subject to expansion or contraction in a manner permitting strains to be evenly distributed.

E. Expansion joints or fittings shall be provided on all piping as specified or otherwise indicated on contract drawings.

F. Piping shall not obstruct openings or passageways.

G. Piping shall be held free of any contact with building construction so as not to transmit noise.

H. All water and air supply piping at each fixture, or unit of equipment, shall be provided with an approved shutoff valve and union - WHETHER INDICATED ON THE CONTRACT DRAWINGS OR NOT - that will permit isolation and disconnection of each item without disturbing the rest of the system.

I. Air supply piping shall be provided with approved sectionalizing valves and valved air inlet connections as required for isolating portions of the system for periodic testing.

J. A union shall be provided within 2 feet of every threaded-end valve installed, unless there are other acceptable connections, which will permit easy removal of the valve.

K. Unions shall also be provided in piping at locations adjacent to all devices or equipment, which may require removal in the future, and at all locations, specified or indicated on the contract drawings.

L. Non-pressure piping installed above electrical panels or cabinets shall be insulated and drip shields shall be installed to contain and channel any condensate or leakage away from the panels or cabinets.

M. Pressure piping shall not be installed above electrical panels or cabinets.

N. All air and digester odor control piping shall be graded to points of drainage collection and approved drip legs and valve shall be installed.

O. Water supply piping within structures shall be arranged, and facilities provided, for complete drainage.

P. All piping serving metering equipment shall be uniformly graded so that air traps are eliminated and complete venting is provided.

S. Taps for pressure gage, switches and thermometers shall be provided with a nipple and an approved shutoff valve.

1. Drilling and tapping of pipe walls for installation of pressure gages or switches will not be permitted.

2. Taps shall be provided by factory threaded taps or a factory welded boss.

3. Install pressure gauges and thermometers in a position to permit reading them from a point approximately 5 feet above floor level.

4. Rigidly support pressure switches and connect them to piping and equipment using a suitable flexible linkage that will not permit transmission of vibrations from the piping or equipment to the pressure switches.

5. Install a valve below each pressure gauge or protective devices unless otherwise specified.

T. All branch connections in horizontal runs of air, gas, or steam piping shall be made from the top of the pipe.

U. In all piping, insulating fittings shall be provided to prevent contact of dissimilar metals wherever copper pipe, tubing, or fittings are connected to iron or steel pipe or fittings.

W. Wherever a solenoid valve is shown on the Drawings or required by the equipment supplied, it shall be electrified as required at no additional cost to the Owner. Minimum conduit size shall be ¾-inch with flexible connector at valve, and minimum wire size shall be 2-#12.

3.08 CHEMICAL PIPING

A. All chemical piping shall be installed so that lines are readily accessible for cleaning.

B. At all exposed changes in direction in chemical piping, tees shall be provided with extra threaded openings plugged to facilitate cleaning.

1. Thread tape or thread sealer shall be applied to the threads of all plugs to facilitate ease of removal.

C. Drip shields shall be installed beneath all elevated chemical piping in areas subject to pedestrian traffic to contain and transport leakage to an approved disposal area.

3.09 PIPE JOINTS

A. Pipe joints shall be provided as specified or as indicated on the contract drawings.

B. Threaded Joints:

1 Pipe threads shall conform to ANSI B2.1, NPT, and shall be full and cleanly cut.

2. Not more than three threads at each pipe connection shall remain exposed after installation.

3. Ends of pipe shall be reamed after threading and before assembly to remove all burrs.

4 Threaded joints in plastic piping shall be made up with Teflon thread tape applied to all male threads.

5. Threaded joints in stainless steel piping shall be made up with Teflon thread sealer and Teflon thread tape applied to all male threads.

6. Thread tape and joint compound or sealers are not to be used in threaded joints, which are to be seal welded.

C. Compression Joints:

1. Ends of tubing shall be square cut and all burrs removed.

2. The tubing end shall be fully inserted into the compression fitting and the nut shall be tightened not less than 1-1 /4 turns, and not more than 1-1 /2 turns past finger-tight, or as recommended by the fitting manufacturer, to produce a leak tight, torque free connection.

D. Flared Joints:

1 The ends of annealed copper tubing shall be cut square and all burrs removed prior to flaring.

2 Ends shall be uniformly flared without scratches or grooves.

3 Fittings shall be tightened as required to produce a leak tight joint.

E. Solder and Brazed Joints:

1. Where solder fittings are specified in lines smaller than 2", joints may be soldered or brazed, at the option of the Contractor.

2. Joints in 2" and larger copper tubing shall be brazed.

3. Joints in copper refrigerant piping shall be brazed.

a. Solder will not be accepted.

4. Surfaces to be joined shall be thoroughly cleaned with flint paper and coated with a thin film of flux.

5. At each joint, tubing shall enter to the full length of the fitting socket.

6. Care should be taken to avoid overheating the metal or flux.

7. While the joint is still hot, all excess filler metal and flux shall be removed with a rag or a brush.

F. Solvent Welded Joints:

1 All joint preparation, cutting, and jointing operations shall comply with the pipe manufacturer's recommendations and ASTM D2855.

2 Pipe ends shall be beveled or chamfered to the dimensions recommended by the pipe manufacturer.

3. Newly assembled joints shall be suitably blocked or restrained to prevent movement during the set time recommended by the manufacturer.

4 Pressure testing of solvent welded piping systems shall not be performed until the applicable curing time, set forth in Table X2.1 of ASTM D2855, has elapsed.

G. Flanged Joints:

1. Flange bolts shall be tightened sufficiently to slightly compress the gasket and affect a seal, but not so tight as to fracture or distort the flange.

2. A plain washer shall be installed under the head and nut of bolts connecting plastic pipe flanges.

3. Anti-seize thread lubricant shall be applied to the threaded portion of all stainless steel bolts during assembly.

4. Connecting flanges shall have similar facings (i.e., flat or raised face).

H. Welded Joints:

1. Welding shall conform to these specifications and recommendations contained in the "Code for Pressure Piping".

3.10 ALIGNMENT

A. All piping shall be installed to lines, grades, and elevations indicated on contract drawings.

B. All deviations from the line, grade, or elevation as indicated on the contract drawings shall be approved in writing by the Engineer.

C. The Contractor is responsible for coordinating all other work to insure that piping is installed as indicated on the contract drawings.

D. Piping intended to be straight shall be straight. Deflections from a straight line or grade shall be approved in writing by the Engineer and shall be accomplished by the use of approved fittings.

E. For buried piping, all pipe subgrades shall be determined and checked by survey.

F. If laser equipment is used for piping installation, periodic elevation measurements shall be made with survey equipment to verify the accuracy of grade or elevation. If such measurements indicate thermal deflection of the laser due to differences between ground or atmospheric temperature and the air temperature within the pipe, steps shall be taken to prevent further thermal deflections.

3.11 PIPE INSULATION

A. All domestic hot water piping, cold water piping, non potable water and roof drain/overflow lines which pass through spaces above finished ceilings, or are suspended over equipment, electrical panels, or cabinets shall be insulated.

B. Piping shall be tested and shall be approved by the Engineer prior to insulation installation.

C. All end joints of insulation shall be tightly butted.

D. All seams and joints shall be held by manufacturer's standard adhesive.

E. Jacket laps shall be neatly pasted in place.

F. All joints shall be pointed with insulating cement.

G. Fittings, flanges, and valves shall be insulated with approved molded insulation or insulating cement of the same thickness as the pipe insulation.

H. Hangers shall permit insulation to pass through and suitable saddles shall be provided to prevent the weight of the piping from being supported by the insulation.

3.12 PROTECTIVE COATING

A. All stainless steel, copper, and black steel pipes in buried locations shall have exterior surfaces protected in accordance with Section 09960, Protection Coating.

3.13 COATING INSPECTION

A. All shop-applied coatings on pipe or fittings shall be inspected for holidays and other defects after receipt of the pipe or fittings on the job site, and again after installation if it is determined by the Engineer that the coating may have been damaged.

1 Inspection shall be made using an electrical holiday detector.

2 The detector used, and inspection procedures, shall be in conformance with the requirements of Section 4.4 of AWWA C209.

B. All field-applied tape wrap on pipe, pipe joints, fittings and valves shall be inspected for holidays and other defects following completion of wrapping and again following installation if it is determined by the INSPECTOR that the wrapping may have been damaged.

C. Holidays and other defects detected during inspection shall be repaired in accordance with the recommendations of the coating or tape wrap manufacturer, as applicable.

1. At the discretion of the Engineer, major areas of defects in pipe coatings may result in rejection of the pipe and its immediate removal from the job-site.

2. At the discretion of the Engineer major areas of defects in pipe coatings may be repaired on site by a qualified representative of the manufacturer or supplier.

3.14 BURIED PIPE

A. All stainless steel and copper pipe in buried locations shall have exterior surfaces protected with a shop-applied plastic coating.

B. Buried pipe shall be protected from lateral displacement by use of the specified pipe embedment and/or encasement.

C. Under no circumstance shall pipe be laid in water.

D. All pipe will be laid on native material unless otherwise specified or indicated on the contract drawings.

E. All pipe subgrade shall be compacted to a relative density of 95%, unless otherwise indicated on the contract drawings.

F. All subgrade shall have compaction tests taken and be approved by the Engineer prior to pipe installation.

H. When pipe laying is interrupted or stopped at the end of the work shift, the open ends of pipe shall be sealed with a watertight plug, or other means acceptable to the Engineer, to prevent water from entering the pipe.

I. Plastic pipe shall be "snaked" in the trench, and shall be kept shaded and shall be covered with backfill immediately following testing.

J. No piping will be encased or backfilled prior to testing and without approval of the Engineer.

3.15 CONCRETE ENCASEMENT

A. All pipe encasement shall be installed where indicated on the contract drawings, per the encasement detail in the contract drawings.

B. Concrete and reinforcement for encasement shall be as specified in the cast-in-place section of these specifications.

C. All pipe to be encased shall be suitably supported and blocked in proper position to allow for complete encasement.

D. All pipe to be encased shall be anchored to prevent floating.

E. All piping to be encased shall be tested as specified and the Engineer shall approve the installation prior to encasement.

3.17 AS BUILT DRAWINGS

A. The CONTRACTOR shall provide surveyed "as-built" drawings for all piping installed.

B. "As-built" drawings shall be provided for buried pipe installations as well as pipe installed in tunnels, galleries, inside buildings, and aboveground outside.

C. For buried pipe installations, surveyed "as-builts" shall include the elevation and location of pipe, valves, and all other pertinent information of the installation, as well as all existing piping or structures in the immediate area.

D. For buried installations, survey shall be taken of location and elevations of all piping installed prior to any encasement or backfill.

E. For buried, encased piping, survey shall be taken both prior to encasement and after the encasement is in place.

F. Drawings shall be forwarded to the Engineer for review and approval within five days after the installation is completed.

G. Progress payment will be withheld for all pipe installations for which "as-built" drawings are not received as specified.

3.18 CLEANING

A. General.

1. This work shall consist of cleaning all piping systems.

B. Materials

1. Equipment. Equipment for cleaning pipe lines includes hoses, pumps, pigs, swabs or other suitable and approved means.

2. Water. Water used for cleaning and flushing drainage pipes shall be fresh disinfected and potable, and free of oil, acid, salt, alkali, organic matter, or any other deleterious substances. The Contractor shall provide all water required for the cleaning operation from sources approved by Engineer.

C. Construction Methods

1. Prior to testing, thoroughly clean the inside of each completed piping system of all dirt, loose scale, sand and other foreign material.

2. Cleaning shall be by sweeping, flushing with water or blowing with compressed air or oil-free nitrogen gas, as appropriate for the size and type of pipe. Flushing shall achieve a velocity of at least 3 feet per second. The Contractor shall install temporary strainers, temporarily disconnect equipment or take other appropriate measures to protect equipment while cleaning piping.

3. All cleaning work shall be performed to the complete satisfaction of the Engineer.

D. Disposal of Debris Collected.

1. All debris collected from pipes and structures shall be legally disposed of in accordance with all applicable State agencies laws and regulations.

3.18 TESTING

A. General: Perform leakage tests on all pipe installed in this project. Furnish all equipment, material, personnel and supplies to perform the tests and make all taps and other necessary temporary connections. The test pressure, allowable leakage and test medium shall be as specified in the following paragraphs. Test pressure shall be measured at the highest point on the line unless specifically noted otherwise. Leakage tests shall be performed on all piping at a time agreed upon and in the presence of the Engineer.

B. Buried Piping: The leakage test for buried piping shall be made after all pipe is installed and backfilled and subgrade has been compacted. However, the Contractor may conduct preliminary tests prior to backfill. If the Contractor elects to conduct preliminary tests, provide any necessary temporary thrust restraint.

C. Exposed Piping: All supports, anchors and blocks shall be installed prior to the leakage test. No temporary supports or blocking shall be installed for final test.

D. Encased Piping: The leakage tests for encased piping shall be made after all pipe is installed and encased, and before any structures are constructed above it. However, the Contractor may conduct preliminary tests prior to encasement. If the Contractor elects to conduct preliminary tests, provide any necessary temporary thrust restraint.

E. Accessories: It shall be the responsibility of the Contractor to block off or remove equipment, valves, gauges, etc., which are not designed to withstand the full test pressure.

F. Testing Apparatus: Provide pipe taps, nozzles and connections as necessary in piping to permit testing including valves to isolate the new system, addition of test media, and draining lines and disposal of water, as is necessary. These openings shall be plugged in a manner favorably reviewed by the Engineer after use. Provide all required temporary bulkheads.

G. Pneumatic Testing: Piping tested by air or another gas shall show no reduction of pressure during the test period after corrections have been made for changes in temperature in conformance with the following relationship:

$$P_1 = P_2$$

$$T_1 = T_2$$

Where T_1 and T_2 are the absolute temperatures of the gas in the pipe and P_1 and P_2 are the absolute pressures. The subscript "1" denotes the starting conditions and the subscript "2" denotes the final conditions.

H. Precautions for Pneumatic Testing: Where air or another gas is called for as the test medium, the Contractor shall take special precautions to protect personnel. During the initial pressurization of a pipeline to the specified test pressure, personnel shall be protected by suitable barricades or shall remove themselves to locations where portions of the concrete structure itself are between them and the pipeline under test.

I. Correction of Defects: If leakage exceeds the allowable, the installation shall be repaired or replaced and leakage tests shall be repeated as necessary until conformance to the leakage test requirements specified herein have been fulfilled. All visible leaks shall be repaired even if the pipeline passes the allowable leakage test.

J. Reports: The Contractor shall keep records of each piping test, including:

1. Description and identification of piping tested.
2. Test pressure.
3. Date of test.
4. Witnessing by Contractor and Engineer.

5. Test evaluation.

6. Remarks, to include such items as:

   a. Leaks (type, location).

   b. Repairs made on leaks.

7. Test reports shall be submitted to the Engineer.

L. Venting: Where not shown on the Drawings, the Contractor may install valved "tees" at high points on piping to permit venting of air. Valves shall be capped after testing is completed.

M. Testing Specifics:

Legend	System	Flow	Test Pressure (PSIG)	Test Medium	Leakage
A	Air	P	25 psig	Air	None
ACP	Compressor Air	P	150 psig	Air	None
CW	Cold Water	P	See Section 15400		
D	Drains	G	See Section 15400		
DSL	Digested Sludge	P	150 psig		None
FEC	Ferric Chloride	P	150 psig		None
HW	Hot Water	P	See Section 15400		
NPW	Non-Potable Water	P	150 psig	Water	None
OD	Odor Control	P	15 psig	Air	None
PLW	Plant Effluent	P	15 psig	Air	None
PS	Plant Sanitary Sewer	P	150 psig	Water	None
		G	5 psig	Water or Air	None
PW	Potable Water	P	150 psig	Water	None
RW	Raw Wastewater	P	150 psig	Water	None

Legend	System	Flow	Test Pressure (PSIG)	Test Medium	Leakage
		G	5 psig	Water or Air	None
SE	Secondary Effluent	P	150 psig	Water	None
		G	5 psig	Water or Air	None
SHC	Sodium Hypochlorite	P	150 psig	Water	None
		G	5 psig	Water or Air	None
SHX	Sodium Hydroxide	P	150 psig	Water	None
		G	5 psig	Water or Air	None
SL	Sludge	S.S.	100 psig	Water	None
SS	Storm Sewer	G	See Section 02630		
VAC	Vacuum Air	P	25 in h.g.	Air	None
V	Vent	G	See Section 15400		

Where:

P = Pressure Line

G =Gravity Line

3.6 CLEANING

A. Prior to testing, thoroughly clean the inside of each completed piping system of all dirt, loose scale, sand and other foreign material. Cleaning shall be by sweeping, flushing with water or blowing with compressed air or oil-free nitrogen gas, as appropriate for the size and type of pipe. Flushing shall achieve a velocity of at least 3 feet per second. The Contractor shall install temporary strainers, temporarily disconnect equipment or take other appropriate measures to protect equipment, persons and property while cleaning piping.

END OF SECTION

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SECTION 15005

DUCTILE IRON PIPE

PART 1 GENERAL

1.01 SCOPE

A. Ductile iron pipe for water and other liquids shall be furnished in the sizes, classes, grades, or nominal thickness and joint types as specified herein or indicated on the contract drawings.

B. It shall be the responsibility of the Contractor to furnish and install all ductile iron piping systems specified herein and as shown on the contract drawings. Each system shall be installed complete with all applicable fittings, hangers, supports, anchors, expansion joints, flexible connections, valves, wall castings, sleeves, and accessories to provide a functional system as specified.

C. The Contractor shall be responsible for all insulation, lining and coating, piping identification, testing, cleaning, disinfecting, excavation, backfill and/or encasement specified herein or as shown on the contract drawings.

D. The Contractor shall furnish all tools, equipment, materials, and supplies and shall perform all labor necessary to complete installation of ductile iron pipe as shown on the contract drawings and specified herein.

1.02 REFERENCES

A. ANSI/AWWA C104/A21.4 - Cement - Mortar Lining for Ductile Iron Pipe and Fittings for Water.

B. ANSI/AWWA C110/A21.10 - Ductile Iron and Gray Iron Fittings.

C. ANSI/AWWA C111/A21.11 - Rubber Gasket Joints for Ductile - Iron and Gray - Iron Pressure Pipe and Fittings.

D. ANSI/AWWA C115/A21.15 - Flanged Ductile - Iron Pipe with Threaded Flanges.

E. ANSI/AWWA C150/A21.50 - Thickness Design of Ductile Iron Pipe.

F. ANSI/AWWA C151/A21.51 - Ductile Iron Pipe, Centrifugally Cast.

G. ANSI/AWWA C153/A21.10-87 - Ductile Iron Compact Fittings, 3 in. through 16 in. for Water and Other Liquids.

H. ANSI/AWWA C600 - Installation of Ductile Iron Water Mains and their Appurtenances.

1.03 SUBMITTALS

A. The Contractor shall complete shop drawings of all piping systems, equipment, accessories, and supports in accordance with the provisions of Section 01300

B. Shop drawings shall include all ductile iron pipe, fittings, gaskets, couplers, hangers, supports, wall castings, sleeves, and all required appurtenances indicated on the contract drawings or as specified herein necessary to provide a complete, operable piping system as specified.

C. The Contractor shall submit for review and approval complete piping lay-out drawings showing piping, fittings, couplers, hangers, supports, wall castings, sleeves, and all required appurtenances indicated on the contract drawings or as specified herein necessary to provide a complete, operable piping system as specified. Lay-out drawings shall indicate any and all interfaces with other systems being installed which may cause interference with the piping system being installed.

D. It is the responsibility of the Contractor to coordinate all work being performed and review all shop drawings to insure that no unnecessary interferences exist.

E. The Contractor shall submit as part of the shop drawings for ductile iron piping a statement from the pipe manufacturer certifying that all pipes is being fabricated per the requirements of these specifications.

1.04 QUALITY ASSURANCE

A. All wall castings shall be shop inspected.

B. Manufacturer shall perform Hydrostatic testing on pipe in conformance with AWWA C151.

C. Each pipe shall have clearly marked on each piece the words "DUCTILE IRON", the weight, class (nominal thickness) and the casting date.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 01600.

B. Deliver and store valves in shipping containers, with labeling in place.

C. Provide temporary protective coating on valves.

D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. All pipe and fittings shall be carefully examined for cracks and other defects prior to shipment. All defective pipe and fittings shall be rejected and replaced.

B. All pipes and equipment shall be supported in accordance with Division 15 of these specifications.

C. All ductile iron piping and fittings shall be cement mortar lined and asphaltic coated inside. Unless otherwise specified, piping and fittings in wet well areas shall be asphaltic coated outside. Cement mortar lining shall be in accordance with AWWA C104. Asphaltic coating shall conform to ANSI/AWWA C151/A21.51 for the pipe and fittings.

D. Exterior exposed and interior piping shall be furnished with outside surfaces prepared in accordance with near white grade SSPC Specification No 10 removing all dirt, rust scale, and foreign materials. Cleaned surfaces shall then be shop primed. Shop priming shall be with one coat of Tnemec 69-1255 Hi-Build Epoxoline primer, or equal, applied to a minimum of 5.0 mils dry thickness Primer used shall be compatible with proposed finish coats, Contractor to verify It is the intent of this specification that all piping, supports and appurtenances shall be furnished shop primed, clean and ready to accept finish painting by Contractor, with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in 09960.

2.02 DUCTILE IRON PIPE

A. General: Ductile iron pipe shall be manufactured in accordance with ANSI/AWWA A21.51/C151.

B. Thickness: Minimum ductile iron pipe shall be provided in accordance with the thickness class listed below:

PIPE SIZE	MINIMUM THICKNESS CLASS
3”	52
4” to 16”	54
18”	54
20”	56
24” and Larger	56
24” with push on joints	56

1. Thickness complies with ANSI/AWWA A21.50/C150 for minimum pipe wall thickness for threaded flanges. Thickness will increase with required increases in service tap diameters.

2. Grooved couplings are available through 24 inch. Larger sizes require cast-on or threaded-on shoulders.

C. Fittings: all ductile iron rubber gasket, push-on, mechanical, and flanged joint fittings shall be manufactured in accordance with AWWA C110.

PART 3 EXECUTION

3.01 HANDLING

A. Pipe, fittings and accessories shall be handled in a manner that will insure installation in sound, undamaged condition.

B. Pipe and fittings with cement mortar or glass lining shall be handled with rubber covered hooks or other type of equipment to prevent damage to the cement lining.

C. Bare forklift arms, hooks, or chains shall not be inserted into open ends.

D. Pipe and fittings in which the lining has been damaged shall be immediately removed from the job site and replaced.

3.02 STORAGE

A. All pipe and fittings shall be stored off the ground.

B. Pipe ends shall be covered to prevent foreign matter from entering the pipe during storage.

C. Pipe shall be stacked using suitable lumber or racks between rows to prevent damage to pipe.

D. Any pipe that becomes damaged or unidentifiable due to improper storage shall be rejected and immediately removed from the job site.

3.03 REPAIR OF CEMENT MORTAR LINING

A. When approved and witnessed by the Engineer, small and readily accessible damaged areas of cement mortar lining may be repaired in conformance with ANSI/AWWA C104/A21.4 and the following:

1. Cut out the damaged lining to the metal, with square edges.

2. Thoroughly wet the cut out area and adjoining lining.

3. With the damaged area cleaned and the adjoining lining wet, spread the mortar evenly over the area to be patched.

4. After the lining patch has become firm and adheres well to the surface, finish it with a wet 3" or 4" paint brush or similar soft bristle brush.

5. The repaired lining shall be kept moist by tying canvas-wet burlap over the ends of the pipe or fitting for 24 hours

6. After the lining patch is dry and hard, the asphaltic coating shall be replaced using approved coating material.

B. Repair mortar shall be in conformance with ANSI/AWWA C104/A21.4 and the following formula:

1. Cement Mortar mix by volume:

   3 parts Portland Cement

   2 parts clean sand

   Necessary clean water for 5" to 8" slump

2. Sand shall be clean, free of clay, and screened through a No. 20 screen.

3.04 CUTTING PIPE

A. Cutting of pipe shall be done in a neat manner, without damage to the pipe or the lining.

B. Cuts shall be smooth, straight, and at right angles to the pipe axis.

C. Pipe shall be cut using a portable guillotine saw, abrasive wheel "cut-off" saw, or milling cutter only. Use of gas torches for cutting pipe will not be permitted.

D. Field cut holes for saddles shall be with mechanical cutters. Gas torch cutting will not be permitted.

E. After cutting, the end of the pipe shall be dressed with a file or power grinder to remove all roughness and sharp edges.

F. All damaged or removed cement mortar lining shall be repaired in accordance with Section 3.03 of these specifications.

3.05 CLEANING

A. The interior of all pipe and fittings shall be thoroughly cleaned of all foreign matter prior to installation, and shall be kept clean until the work has been accepted.

B. Before jointing, all joint contact surfaces shall be wire brushed, wiped clean, and kept clean until jointing is completed.

C. Flange faces shall be wire brushed and cleaned to remove all oil, grease, loose primer, mill scale or any other foreign matter, which could affect the proper seating of the gasket.

D. When pipe installation is stopped, precautions shall be taken to prevent foreign material from entering the pipe.

E. Prior to testing, the entire pipeline shall be flushed until the flushing water runs clear and clean.

F. Cleaning for final acceptance shall be in conformance with applicable sections of these specifications.

G. Cleaning of fresh and potable water lines shall be in accordance with these specifications, Bucks County Department of Health requirements, and shall be done under the supervision of the Engineer and HTWSA Operations.

3.06 ALIGNMENT

A. Piping shall be installed to the lines and grades indicated on the contract drawings.

B. Pipelines intended to be straight shall be laid straight. Deflections from a straight line or grade shall not exceed the values stipulated in Table 5 of ANSI/AWWA C600, unless specially designed and approved bells and spigots are provided.

C. Batter boards, laser beam equipment, or survey shall be used in all pipe installations to maintain alignment and grade.

D. Batter boards, if used, shall be erected at intervals not to exceed 25 feet.

E. All pipe subgrades shall be determined and checked by survey.

F. If laser equipment is used, periodic elevation measurements shall be made with survey equipment to verify accuracy of grade or elevation. If such measurements indicate thermal deflection of the laser due to differences between ground temperature and the air temperature within the pipe, steps shall be taken to prevent further thermal deflections.

3.07 AS-BUILT DRAWINGS

A. The Contractor shall provide surveyed "as-built" drawings for all piping installed.

B. "As-built" drawings shall be provided for buried pipe installations as well as pipe installed in tunnels, galleries, inside buildings, or above ground outside.

C. For buried pipe installations, surveyed "as-built" shall include the elevation and location of pipe, valves, and all other pertinent information on the installation, as well as all existing piping or structures in the immediate area.

D. For buried pipe installations, survey shall be taken of location and elevations of all piping installed prior to any encasement or backfill.

E. For buried, encased piping, survey shall be taken both prior to encasement and after the encasement is in place.

F. Drawings shall be forwarded to the Engineer for review and approval within five days after installation is completed.

G. Progress payment will be withheld for all pipe installations for which "as-built" drawings are not received as specified.

3.08 LAYING PIPE

A. Buried pipe shall be protected from lateral displacement by use of the specified pipe embedment and/or encasement.

B. Under no circumstance shall pipe be laid in water.

C. All pipes will be laid on native material unless otherwise indicated on the contract drawings.

D. All pipe subgrade shall be compacted to 95% of maximum density per ASTM D1557, unless otherwise indicated on the contract drawings.

E. All subgrade shall have compaction tests taken and be approved by the INSPECTOR prior to pipe installation.

F. When pipe lying is interrupted, or stopped at the end of the work shift, the open ends of pipe shall be sealed with a watertight plug, or other means acceptable to the Engineer, to prevent water from entering the pipe.

3.09 FIELD JOINTS

A. All joints in buried locations shall be mechanical joints unless otherwise indicated in these specifications or on the contract drawings.

B. All joints of piping above ground outside, in tunnels, galleries, or inside buildings shall be flanged type "rigid" joints unless otherwise indicated in these specifications or on the contract drawings.

C. All buried ductile iron pipe joints shall be field coated with a minimum 12 mils of an approved coal tar coating. The coating shall cover the entire joint, including fasteners. If soil or field conditions warrant, pipe shall be poly wrapped in accordance with AWWA specifications.

D. When specified or indicated on the contract drawings, bells on flush mounted wall castings and wall sleeves shall be mechanical joint type with tapped holes for tie rods or stud bolts.

E. When specified or indicated on the contract drawings, all wall castings other than flush mounted castings and wall sleeves shall be standard mechanical joint flanged joints as indicated.

3.10 MECHANICAL JOINTS

A. When specified or indicated on the contract drawings, mechanical joints shall be carefully assembled in accordance with ANSI/AWWA C110/A21.10 and ANSI/AWWA C111/A21.11 and the manufacturer's recommendations.

B. If effective seating is not obtained, the joint shall be disassembled, thoroughly cleaned, and reassembled.

C. Bolts shall be uniformly tightened to the torque values listed in Appendix A of ANSI/AWWA C111/A21.11.

D. Over tightening of bolts to compensate for poor installation will not be permitted.

E. Holes in mechanical joints with tie rods shall be carefully aligned to permit installation of the tie rods.

F. In flange and mechanical joint pieces, holes in the mechanical joint bells and the flanges shall straddle the top (or side for vertical piping) centerline. The top centerline shall be marked on each flange and mechanical joint piece at the foundry.

G. Minimum Number of Tie Rods:

Pipe Size	Operating Pressure					
	< 50	75	100	125	150	200
3",4" and 6"	2	2	2	2	2	2
8"	2	2	2	2	4	4
10"	2	4	4	4	4	4
12"	2	4	4	4	6	6
14"	4	6	6	8	8	10
16"	6	6	6	8	8	12
18"	6	6	8	10	10	12
20"	8	10	10	12	12	12
24"	10	10	12	16	16	

3.11 PUSH-ON JOINTS

A. When specified or indicated on the contract drawings, joints shall be installed in conformance with ANSI/AWWA C111.A21.11 and the pipe manufacturer's instructions and recommendations for proper jointing operations.

B. All joint surfaces shall be properly lubricated with approved heavy vegetable soap solution immediately before the joint is completed.

C. Lubricant shall be suitable for use in potable water, shall be stored in closed containers, and shall be kept clean at all times.

D. Each spigot end of the pipe shall be suitably beveled to facilitate assembly.

3.12 FLANGED JOINTS

A. When specified or indicated on the contract drawings, flanges shall conform to ANSI B16.1, B16.2, and B21.10.

B. Bolts shall be tightened gradually and at a uniform rate to facilitate uniform gasket compression.

C. Care shall be taken when connecting to equipment to insure that pipe stresses are not transmitted to the equipment flanges.

D. All flanged piping connecting to equipment shall be permanently supported so that accurate matching of bolt holes and uniform contact over the entire surface of abutting pump and piping flanges are obtained before the installation of any bolts in these flanges.

E. Equipment connection piping shall be free to move parallel to its longitudinal centerline while the bolts are being tightened.

F. Each piece of equipment shall be leveled, aligned, and placed into position, but shall not be grouted until the initial fit-up and alignment of the pipe is completed.

G. Each piece of equipment shall be grouted before final bolting of the connecting piping.

3.13 FLANGED COUPLING ADAPTERS

A. When specified or indicated on the contract drawings, flanged coupling adapters shall be installed in strict accordance with manufacturer's recommendations and instructions.

3.14 MECHANICAL COUPLINGS

A. When specified or indicated on the contract drawings, mechanical couplings shall be installed in accordance with the manufacturer's recommendations and instructions.

B. A space of at least 1/4", and not more than 1", shall be left between the pipe ends.

C. All assembly bolts shall be uniformly tightened so that the coupling is free from leaks and all parts of the coupling are square and symmetrical with the pipe.

D. Following installation of the coupling, damaged areas of shop coatings of the pipe and coupling shall be repaired to the satisfaction of the Engineer.

3.15 WALL CASTINGS

A. Unless otherwise specified or indicated on the contract drawings, wall castings shall be provided where ductile iron pipe passes through concrete walls.

B. Where a flange and mechanical joint piece is to connect to a mechanical joint wall casting, the bolt holes in the bell of the wall casting shall straddle the top (or side for vertical piping) center line of the casting and shall align with the bolt holes in the flange and mechanical joint piece. The top centerline shall be marked on the wall casting at the foundry.

3.16 WALL SLEEVES

A. Wall sleeves are to be provided where ductile iron pipe passes through concrete floors and where otherwise specified or indicated on the contract drawings.

B. Wall sleeves are to be sealed using modular casing seals ("link seals") and approved caulking on both sides of the floor penetration.

3.17 REDUCERS

A Reducers, adjacent to flow meters and pumps or in other locations as specified or indicated on the contract drawings, shall be eccentric pattern, installed with the straight side on top so that air traps are not formed. All other reducers shall be concentric pattern.

3.18 OUTLETS

A. Where a 12" or smaller branch outlet is specified or indicated on the contract drawings, and the diameter of the line pipe is at least twice the diameter of the branch, either a tee or factory welded-on boss shall be used.

B. Connections of gauges to 6" and smaller pipe shall be made using a tee complete with blind flange drilled and tapped to accept the gauge piping specified.

C. Connections of gauges to 8" and larger piping shall be made by means of a factory welded-on boss.

D. Tapping saddles shall be used for "hot taps" in specified instances or as shown on the contract drawings.

1 Use of tapping saddles must be approved in writing by the Engineer prior to use in every instance.

3.19 CONNECTIONS TO EXISTING PIPING

A. Connections between new work and existing piping shall be made using fittings submitted and approved by the Engineer for each separate condition encountered.

B. Each connection to existing pipe shall be made at a time and under conditions, which will least impact normal plant operations, and as authorized in writing by the Engineer.

C. The Contractor is responsible for making provisions for cutting of existing pipe when necessary, using approved mechanical means. Flame cutting of pipe will not be allowed.

D. The Contractor is responsible for making provisions for dewatering existing lines and for disposal of water from the dewatering operation.

E. Prior to construction, the Contractor shall submit for review and approval detailed procedures for pressure testing and the making of final connections to existing lines.

F. When connecting to existing fresh and potable water lines, all new piping and fittings shall be cleaned and disinfected prior to making the connection.

1. Provisions shall be made to prevent any cross-connection and contamination of existing lines.

2. Trench water, mud, or other contaminants shall not be allowed to enter the lines.

G. The Contractor is responsible for disinfection and chlorination of all fresh and potable water lines after connections are made in conformance with these specifications.

3.20 CONCRETE ENCASEMENT

A. All pipe encasement shall be installed where indicated on the contract drawings, per the detail in the contract drawings.

B. Concrete and reinforcement for encasement shall be as specified in the cast-in-place concrete section.

C. All pipes to be encased shall be suitably supported and blocked in proper position.

D. All pipes to be encased shall be anchored to prevent floating.

E. All pipes to be encased shall be tested as specified and the Engineer will approve the pipe installation prior to encasement.

3.21 REACTION ANCHORAGE

A. All buried piping shall have thrust blocks placed at all changes of direction, tees, y-branches, valves, and at ends of pipe runs.

B. All piping with mechanical couplings or mechanical joints subject to internal pressure shall be anchored to prevent separation of joints.

C. All mechanical joint tees, y-branches, bend deflecting 22-1/2 degrees or more, and plugs that are installed in piping shall be provided with approved retainer glands.

D. When placing thrust blocks, the concrete shall extend from the pipe to solid, undisturbed earth, and all joints shall remain accessible for repair.

E. The dimensions of all concrete blocking shall be as indicated on the contract drawings, or as directed by the Engineer to accommodate field conditions.

F. If adequate support against undisturbed earth cannot be obtained, metal harness anchorages shall be provided.

1. Metal harness anchorages shall consist of steel rods extending across the joint and securely anchored to the pipe.

G. All reaction anchorage shall be installed prior to pressure testing of any pipe.

3.22 PRESSURE AND LEAKAGE TESTING

A. All pipe installations shall be hydrostatically tested for a period of two hours at pressure specified.

B. All pressure testing shall be done in the presence of, and approved by, the Engineer.

C. All pipe supports and reaction anchorage/seismic anchorage must be installed prior to pressure testing.

1. Buried pipe may be center-loaded to preclude movement prior to testing.

D. The high point of all pipe installed shall be vented.

E. All leaking piping must be completely retested following repairs of leaks.

F. Acceptable leakage is zero.

G. If changes are made to piping installation after initial testing, such as addition of valves, routing changes, branches, etc., the entire line must be retested.

H. Testing against valves will not be permitted. All sections of pipe to be tested must be blind-flanged.

3.23 DISINFECTION

A. Disinfection of ductile iron pipe used for potable water shall be performed in conformance with Section 15400.

END OF SECTION

SECTION 15100

VALVES

PART 1 GENERAL

1.01 SCOPE

A. The Contractor shall provide all tools, supplies, materials, equipment, and labor necessary for furnishing, epoxy coating, installing, adjusting, and testing of all valves and appurtenant work, complete and operable, in accordance with the requirements of the Contract Documents. Where buried valves are shown, the Contractor shall furnish and install valve boxes to grade, with covers, extensions, and position indicators.

1.02 REFERENCES

ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800
ANSI B16.5	Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and Other Special Alloys
ANSI/ASME B1.20.1	General Purpose Pipe Threads (inch)
ANSI/ASME B31.1	Power Piping
ASTM A 36	Specification for Structural Steel
ASTM A 48	Specification for Gray Iron Castings
ASTM A 126	Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A 536	Specification for Ductile Iron Castings
ASTM B 61	Specification for Steam or Valve Bronze Castings
ASTM B 62	Specification for Composition Bronze or Ounce Metal Castings
ASTM B 148	Specification for Aluminum-Bronze Castings
ASTM B 584	Specification for Copper Alloy Sand Castings or General Applications
ANSI/AWWA C500	Gate Valves for Water and Sewerage Systems
ANSI/AWWA C502	Dry-Barrel Fire Hydrants
ANSI/AWWA C503	Wet-Barrel Fire Hydrants
ANSI/AWWA C504	Rubber-Seated Butterfly Valves

ANSI/AWWA C506	Backflow Prevention Devices - Reduced Pressure Principle and Double Check Valves Types
ANSI/AWWA C507	Ball Valves 6 inches through 48 inches
AWWA C508	Swing-Check Valves for Waterworks Service, 2 inches Through 24 inches NPS
ANSI/AWWA C509	Resilient-Seated Gate Valves for Water and Sewage Systems
AWWA C550	Protective Interior Coatings for Valves and Hydrants
SSPC-SP-5	White Metal Blast Cleaning
MSS-SP-70	Manufacturers Standardization Society of the Valve and Fitting Industry; Cast Iron Gate Valves

1.03 SUBMITTALS

A. Submit under the provisions of Section 01300.

B. Shop Drawings: Indicate in large scale detail, fabricated equipment showing construction methods and locations in plan and cross section, mounting requirements and clearances, and utility requirements as to types, sizes and locations.

1. The following submittals and specific information shall be provided.

a. Shop Drawings: Shop drawings of all valves and operators including electrical data shall be furnished. For control system, indicate service connections, characteristics and wiring diagrams.

b. Valve Labeling: The Contractor shall submit a schedule of valves to be labeled indicating in each case the valve location and the proposed wording for the label.

C. Product Data: Provide equipment dimensions and construction, equipment capacities, characteristics and limitations, materials, finishes, utility requirements and locations.

D. Manufacturer's Installation Instructions: Indicate installation requirements and special procedures.

1.04 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years

1.05 QUALITY ASSURANCE

A. Perform work in accordance with Section 01400.

B. Valve Testing: Valves shall be shop tested per manufacturer's recommendations and applicable AWWA/ANSI specifications prior to shipment. Manufacturer's certification

that valves have been shop tested shall be submitted for approval 30 days prior to scheduled shipment.

C. Bronze Parts: Unless otherwise specified, all interior bronze parts of valves shall conform to the requirements of ASTM B 62, or, where not subject to dezincification, to ASTM B 584.

D. The Contractor shall demonstrate that each valve installed as a part of a piping system will operate under field conditions in a manner consistent with the design of the system. All testing of valves shall be witnessed and approved by the Engineer.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle equipment according to manufacturer's instructions and the provisions of Section 01600.

B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

C. Provide temporary protective coating on cast iron and steel valves.

1.07 SCHEDULING AND COORDINATION

A. Schedule work under the provisions of Section 01300.

B. Coordinate the delivery and installation of the work of this section with the work of other sections.

1.08 WARRANTY

A. The manufacturer shall provide a warranty against any defect or malfunction due to workmanship in the equipment and accessories for a period of one year from date the system is put into service.

B. A written manufacturer's warranty shall be supplied.

1.09 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 01730.

B. Operation Data: Provide operating data for specified equipment.

C. Maintenance Data: Provide lubrication and periodic maintenance requirements and schedules.

1.10 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 01725.

PART 2 PRODUCTS

2.01 VALVES - GENERAL

A. General: The CONTRACTOR shall furnish all valves, operators, actuators, valve-operating units, stem extensions, and other accessories as shown or specified. All valves shall have the name of the manufacturer and the site of the valve cast on the body or bonnet or shown on a permanently attached plate in raised letters. All valves and gates shall be new and of current manufacture. All shut-off valves, 6-inch and larger, shall have operators with position indicators. Where buried, these valves shall be provided with valve boxes and covers containing position indicators, and valve extensions. Shut-off valves mounted higher than 5 feet 6 inches above working level shall be provided with chain operators.

B. Valve Flanges: The flanges of valves shall be in accordance with Section 15100, "Piping, General".

C. Gate Valve Stems: Valves with motorized operators shall have stems conforming to ASTM A276 Type 316 stainless steel with minimum tensile strength of 95,000 psi, and a minimum yield point of 75,000 psi, and elongation of 25% in 2 inches. Manually operated valves shall have silicon-bronze stems conforming to ASTM B 584-875, having minimum tensile strength of 60,000 psi, a minimum yield point of 24,000 psi, and elongation of 16% in 2 inches. Where subject to dezincification, manually operated valve stems shall be of bronze conforming to ASTM B62, containing no more than 5% zinc, nor more than 2% aluminum.

D. Protective Coating: Except where otherwise specified, ferrous surfaces, exclusive of stainless steel surfaces, in the water passages of all valves 4-inch and larger, as well as the exterior surfaces of all submerged valves, shall be coated as specified in Section 09960, "Protective Coating". Flange faces of valves shall not be coated. The valve manufacturer shall certify in writing that such coating has been applied and tested in the manufacturing plant prior to shipment, in accordance with these Specifications.

E. Valve Operators: Where shown, certain valves and gates shall be furnished with electric operators, provided by the valve or gate manufacturer. The same manufacturer shall furnish all operators of a given type. Where different manufacturers supply these operators, the CONTRACTOR shall coordinate their selection to provide uniformity of each type of electric operator. All valve operators, regardless of type, shall be installed, adjusted, and tested by the valve manufacturer at the manufacturing plant. The motor operated valves are shown in Tables. Unless otherwise specified, all electric, pneumatic, and hydraulic valve operators shall be in accordance with "Valve Operators".

F. Valve Labeling: Except when such requirement is waived by the ENGINEER in writing, a label shall be provided on all shut-off valves exclusive of hose bibs and chlorine cylinder valves. The label shall be of 1/16-inch plastic or stainless steel, minimum 2 inches by 4 inches in size, as specified in Section 15190, "Mechanical Identification", and shall be

permanently attached to the valve or on the wall adjacent to the valve as directed by the ENGINEER.

G. Nuts and Bolts: All nuts and bolts on valve flanges and supports shall be Type 316 stainless steel.

2.02 GATE VALVES

A. General

1. All buried valves shall be of the inside screw type. Valves shall be capable of being repacked under line pressure. Valves 14-inch and larger installed in vertical pipes with their stems horizontal shall be fitted with bronze slides, tracks, rollers, and scrapers to assist the travel of the gate assembly. Quick opening valves shall have quick opening levers and cams in lieu of handwheel operators. For other operators see "Valve Operators:" All ferrous surfaces of the valves, 4-inch and larger, which will be in contact with water shall be epoxy-coated as specified in Section 09960, "Protective Coating."

B. Resilient-Seated Gate Valves

1. Resilient-seated gate valves are used in applications where infrequency of valve operation, or process conditions requires resilient seating surfaces. Resilient-seated gate valves shall conform to ANSI/AWWA C509. Resilient-seated gate valves shall have cast iron bodies with flanged, bell, or mechanical joint ends, rubber-coated cast iron disc, flanged bonnet, bronze stem, O-ring seals, rising stems, and operators with handwheel or square nut, unless otherwise shown.

2. Manufacturers, or approved equal:

a. A -C Valves, Inc

b. Clow Corporation

c. Kennedy Valve Mfg. Co., (ITT Grinnell)

d. Mueller Company

e. Stockham Valves and Fittings

C. Gate Valves (Smaller Than 3-Inch)

1. Construction: Gate valves, smaller than 3-inch, for general purpose use shall be heavy duty type for industrial service, with screwed or soldered ends to suit piping. The bodies shall be bronze and have screwed tops or union bonnets, of bronze conforming to ASTM B-62, with bronze stems, solid wedges, metal handwheels, and Teflon-impregnated or other acceptable packing. All valves shall have rising stems unless otherwise specified or shown. All valves shall have a minimum pressure rating of 125-psi steam, or 200 psi Cold water, unless otherwise specified or shown.

2. Manufacturers, or approved equal

   a. Crane Company

   b. Milwaukee Valve Company

   c. Wm. Powell Company

   d. Stockham Valves and Fittings

2.03 BUTTERFLY VALVES

A. Butterfly Valves (AWWA)

1. General: Butterfly valves shall conform to ANSI/AWWA C504 subject to the following requirements. Valves shall be of the size and class shown. Flanged valves shall have 125-lb American Standard flanges and unless otherwise shown, may be either short-bodied or long-bodied. Shaft seals shall be designed for use with standard split-V type packing, or other acceptable seal. The interior passage of butterfly valves shall not deviate from the nominal diameter by more than one-inch nor shall it have any obstructions or stops.

2. Coating: All corrosive ferrous surfaces of valves, 4-inch and larger, which will be in contact with water, exclusive of flange faces shall be epoxy-coated as specified in Section 09600, "Protective Coating."

3. Manual Operators: Operators shall conform to ANSI/AWWA C504, subject to the following requirements. Unless otherwise shown, all manually operated butterfly valves shall be equipped with a handwheel and 2-inch square operating nut and position indicator.

4. All submerged and buried valves, shall be equipped with worm-gear operators, lubricated and sealed to prevent entry of dirt or water into the operator.

5. Manufacturers, or approved equal:

   a. A-C Valves, Inc

   b. Clow Corporation

   c. De Zurik Corporation

   d. Henry Pratt Company

B. Butterfly Valves For Air And Gas Service

1. General: Butterfly valves for air and gas systems shall be specifically designed for this service and meet or exceed the design, strength, performance, and testing standards of ANSI/AWWA C 504. They shall be suitable for pressures from vacuum to 125 psi, and temperatures from minus 40 degrees F to 250 degrees F.

2. Body: The valve body shall be of cast iron conforming to ASTM A126, class B, with either wafer, lug, or flanged design, as shown, drilled to ANSI B 16.1, class 125.

3. Disc: The disc shall be of ductile iron to conforming ASTM A536 with an edge of monel, Type 316 stainless steel, or nickel; it shall be designed with the air-profile or other suitable shape. Sprayed or plated disc edges are not acceptable.

4. Seat: The elastomer seat shall be in the body. It shall be field-replaceable without special tools. Except for use with petroleum-base fluids, the seat material shall be Ethylene-Propylene-Diene Monomer (EPDM), or other suitable material, to provide a tight shut-off at the above-mentioned temperatures. The elastomer thickness shall be minimum ½-inch, exclusive of backing rings, or stiffeners.

5. Shaft: The valve shaft shall be of stainless steel, with sufficient strength to allow for the increased torque for air service.

6. Bearings: All shaft bearings shall be of the self-lubricating corrosion resistant sleeve type.

7. Packing: The packing shall be of the adjustable or self-adjustable type, suitable for the temperature and service conditions.

8. Actuators: All valve actuators shall be in accordance with "Valve Operators." They shall be sized for air service applications with the torque condition after 3 years of service. Manual actuators shall allow for positive throttling and locking in any position from open to closed.

9. Testing: All valves shall be factory leak tested in accordance with ANSI/AWWA C 504.

10. Manufacturers, or approved equal:

    a. A-C Company

    b. De Zurik Corporation

    c. Keystone Valve - USA.

2.04 PLUG VALVES

A. Eccentric Plug Valves

1. Equipment Requirements: Eccentric plug valves shall be of the non-lubricated eccentric type with cast iron bodies, resilient faced plugs, or a replaceable, resilient seat in the body. Eccentric plug valves for digester gas service shall have Type 316 stainless steel plugs and suitable resilient seating, like Buna N, Hycar, or equal. Unless otherwise shown or specified, all valves for sizes 4-inch and larger shall have worm gear operators, nickel or stainless steel seats, and

ANSI 125 psi flanged or grooved ends. Valves 3-inch and smaller shall have operating levers, nickel or stainless steel seats, and screwed ends. Resilient facing shall be suitable for the intended service. All submerged and buried valves, shall be equipped with worm-gear operators, lubricated and sealed to prevent entry of dirt and water into the operator. All shaft bearings shall be of stainless steel, furnished with permanently-lubricated bearing surfaces. The operator shall clearly indicate valve position. All valves up to and including 20-inch in size shall have an unobstructed port area of not less than 80 percent of full pipe area, and not less than 70 percent for larger valves, unless otherwise specified. All eccentric plug valves shall have a pressure rating of not less than 150 psi WOG, for bubble-tight shut-off.

2. Surface Coating: Ferrous surfaces of valves, 4-inch and larger, which will be in contact with process fluid, shall be epoxy-coated as specified in Section 09960, "Protective Coating."

3. Manufacturers, or approved equal:

   a. Clow Corporation

   b. DeZurik Corporation

   c. Keystone, Drum-Owens, (Homestead)

   d. Victualic Company of America.

2.05 CHECK VALVES

A. Swing Check Valves (3-Inch And Larger)

1. General: Swing check valves for water, sewage, sludge, and general service shall be of the outside lever and spring or weight type, in accordance with AWWA C 508, unless otherwise specified below, full-opening; designed for a water-working pressure of 150 psi unless otherwise shown, and shall have a flanged cover piece to provide access to the disc. Corrosive ferrous surfaces of valves, 4-inch and larger, which will be in contact with water, shall be epoxy-coated as specified in Section 09960, "Protective Coating".

2. Body: The valve body and cover shall be of cast iron conforming to ASTM A 126, with flanged ends conforming to ANSI B 16.1, or mechanical joint ends, as shown.

3. Disc: The valve disc shall be of cast iron, ductile iron, or bronze conforming to ASTM B 62.

4. Seat and Rings: The valve seat and rings shall be of bronze to conforming ASTM B 62 or B 148, or of Buna-N.

5. Hinge Pin: The hinge pin shall be of bronze or stainless steel.

6. Manufacturers, or approved equal:

    a. American-Darling Valve Co.

    b. APCO (Valve and Primer Corp.)

    c. Crane Company

    d. Clow Corporation

    e. Kennedy Valve Mfg. Co. (ITT Grinnell)

    f. Mueller Company;

    g. Stockham Valves and Fittings.

B. Swing Check Valves (2-1/2-Inch And Smaller)

1. General: Swing check valves for steam, water, oil, or gas in sizes 2-1/2-inch and smaller shall be suitable for a steam pressure of 150 psi and a cold water pressure of 300 psi. They shall have screwed ends, unless otherwise shown, and screwed caps.

2. Body: The valve body and cap shall be of bronze conforming to ASTM B 61 and with threaded ends conforming to ANSI/ASME B1.20.1.

3. Disc: Valves for steam service shall have bronze discs, and for cold water, oil, and gas service replaceable composition discs.

4. Hinge Pin: The hinge pins shall be of bronze or stainless steel.

5. Manufacturers, or approved equal:

    a. Crane Company

    b. Milwaukee Valve Company

    c. Stockham Valves and Fittings

    d. Wm. Powell Company

C. Internal Spring-Loaded Check Valves (Globe Style)

1. General: Internal spring-loaded check valves for water pumps, compressors, gas and air shall be of the full-flow internal spring-loaded poppet type. The valves shall be designed for a water-working pressure of not less than 150 psi unless otherwise shown. Corrosive ferrous surfaces of valves 4-inch and larger shall be epoxy-coated as specified in Section 09960, "Protective Coating".

2. Body: The bodies of all valves in sizes 3-inch and larger shall be of cast iron with 125-lb flanged ends conforming to ANSI B 16.1 unless otherwise shown. There shall be a positive, watertight seal between the removable seat and the valve

body. The stem guide shall be integrally cast with the body, or screwed into the body.

3. Valves smaller than 3 inches shall have bronze bodies with screwed ends conforming to ANSI/ASME B 1.20.1, suitable for a minimum working pressure of 200 psi, and a temperature of 250 degrees F, unless otherwise shown or specified. The type of bronze shall be suitable for the intended service.

4. Disc and Stem: The disc and stem of all valves in sizes 3-inch and larger shall be of bronze or stainless steel. The stem shall have two-point bearings. The downstream bearing shall have a bronze or other suitable bushing, to provide a smooth operation.

5. Valves smaller than 3 inches shall have discs and retaining rings of Teflon, Nylon, or other suitable material, and stems of bronze, brass, or stainless steel, suitable for the intended service.

6. Seat: All valves for general service at temperatures up to 250 degrees F shall have bubble-tight shut-off with resilient seats of Buna-N, Teflon, or other suitable material. Valves for steam service and temperatures over 250 degrees F shall have metal-to-metal seating of bronze or stainless steel, as recommended by the manufacturer for the specific service condition. All resilient seats shall be firmly attached to the seating ring by compression-molding or other acceptable method.

7. Spring: All valves in sizes 3-inch and larger shall have stainless steel springs, and valves smaller than 3-inch shall have stainless steel or beryllium copper springs, as suitable for the service. The spring tension of the valves shall be designed for the individual pressure condition of each valve.

8. Manufacturers, or approved equal:

   a. APCO (Valve and Primer Corp.)

   b. Miller Valve Co., Inc.

   c. VAL-MATIC (Valve and Manufacturing Corporation)

D. Plastic Ball Check Valves

1. General: Plastic ball check valves for corrosive fluids, in sizes up to 4-inch, shall be used for vertical upflow conditions only, unless the valves are provided with spring actions.

2. Construction: The valve bodies and balls shall be of polyvinyl chloride (PVC), chlorinated polyvinyl chloride (CPVC), polyvinylidene fluoride (PVDF), or polypropylene (PP) construction, as best suited for each individual service condition. They shall have unions with socket connections, or flanged ends conforming to ANSI B16.5, class 150. All seals shall have Viton O-rings and valve

design shall minimize possibility of the balls sticking or chattering. The valves shall be suitable for a maximum working non-shock pressure of 150 psi at 73 degrees F.

3. Manufacturers, or approved equal:

    1. ASAHI-AMERICA;

    2. Harrington Industrial Plastics, Inc.

    3. NIBCO Inc. (Chemtrol).

E. Plastic Swing Check Valves

1. General: Plastic swing check valves for corrosive fluids, in sizes up to 8 inches, may be used for horizontal or vertical upflow conditions.

2. Construction: The valve bodies and discs shall be of PVC, PP, or PVDF construction, as best suited for each individual service condition. They shall have flanged ends conforming to ANSI B16.5, class 150, and flanged top access covers, and they shall shut positively at no-flow conditions. The seats and seals shall be of EPDM, Teflon, or Viton. The PVC valves shall be rated for a maximum non-shock working pressure of 150 psi at 73 degrees F for sizes 3-inch and smaller. For larger sizes and other materials and temperatures the pressure rating will be lower.

3. Manufacturers, or approved equal:

    1. ASAHI-AMERICA

    2. Harrington Industrial Plastics, Inc.

2.06 BALL VALVES

A. Ball Valves (4-Inch And Smaller)

1. General Requirements: Unless otherwise specified or shown, general purpose ball valves in sizes up to 4-inch shall have manual operators with lever or handwheel. For other operators see "Valve Operators." Ferrous surfaces of 4-inch valves, which will be in contact with water, shall be epoxy-coated as specified in Section 09960, "Protective Coating." All ball valves shall be of best commercial quality, heavy-duty construction

2. Body: All ball valves up to 1.5-inch (incl.) in size shall have bronze or forged brass 2- or 3-piece bodies with screwed ends for a pressure rating of not less than 300 psi WOG. Valves 2-inch to 4-inch in size shall have bronze forged brass or steel 2-or 3-piece bodies with flanged ends for a pressure rating of 125 psi or 150 psi.

3. Balls: The balls shall be solid brass or chrome plated bronze, or stainless steel, with large or full openings.

4. Stems: The valve stems shall be of the blow-out proof design, of bronze, stainless steel, or other acceptable construction, with reinforced Teflon seal.

5. Seats: The valve seats shall be of Teflon or Buna-N, for bi-directional service and easy replacement.

6. Manufacturers, or approved equal:

    1. Jamesbury Corporation
    2. Jenkins Bros.
    3. Lunkenheimer Flow Control
    4. Wm. Powell Company
    5. Worcester Controls

B. Plastic Ball Valves

1. General Requirements: Plastic ball valves for corrosive fluids shall be made of polyvinyl chloride (PVC), chlorinated polyvinyl chloride (CPVC), or polyvinylidene fluoride (PVDF), as recommended by the manufacturer for any specific applications. All valves shall have manual operators, unless otherwise specified or shown.

2. Construction: All plastic ball valves shall have union ends or flanged ends conforming to ANSI B 16.5, class 150, for easy removal. The balls shall have full size ports and Teflon seats. All body seals, union O-ring seals, and stem seals shall be Viton. The valves shall be suitable for a maximum working non-shock pressure of 150 psi at 73 degrees F for PVC, with decreasing ratings for higher temperatures and other plastics.

3. Manufacturers, or approved equal:

    1. ASAHI-America
    2. G F Plastic Systems, Inc.
    3. ITT Engineered Valves
    4. NIBCO Inc., (Chemtrol)
    5. Watts Regulator Company

2.07 DIAPHRAGM VALVES

A. General: All diaphragm valves shall be of the weir type, unless otherwise shown, suitable for throttling service and installation in any position. The polyvinyl chloride (PVC) valves shall have a pressure rating of 150 psi at 73 degrees F to 15 psi at 140 degrees F. The chlorinated polyvinyl chloride (CPVC) valves shall have a pressure rating

of 150 psi at 73 degrees F to 40 psi at 210 degrees F. All valves shall have bubble-tight shut-off.

B. Construction

1. Body: Unless otherwise shown, valve bodies shall be of PVC or CPVC, conforming to ASTM D 1784, as best suited for the individual service, with union ends or flanged ends conforming to ANSI B16.5, 150 psi. The valves shall have flanged tops with position indicators. Diaphragm valves on outlet and drain nozzles of storage tanks shall have cast iron or ductile iron bodies with plastic linings to best withstand the chemicals for which they are used.

2. Diaphragm: The diaphragms of all valves shall be of a chlorosulfonated polyethylene such as Hypalon, or equal, except that the diaphragms for valves in chlorine solutions and chlorine gas lines shall be Teflon.

3. Operator: Unless otherwise shown, all valves shall be handwheel-operated. Handwheels shall be made of suitable plastic material, or material with plastic coating. Where pneumatic or electric operators are specified or shown, they shall be furnished and assembled by the valve manufacturer, complete with limit switches, positioners, and accessories as a functional unit, unless otherwise shown.

C. Manufacturers, or approved equal:

1. Hayward

2. Hills-McCanna Company

3. ITT Engineered Valves

4. NIBCO, Inc. (Chemtrol)

2.08 AIR-VACUUM AND AIR-RELEASE VALVES

A. Air and Vacuum Valves: Air and vacuum valves shall be capable of venting large quantities of air while pipelines are being filled, and allowing air to re-enter while pipelines are being drained. They shall be of the size shown, with flanged or screwed ends to match piping. Bodies shall be of high-strength cast iron. The float, seat, and all moving parts shall be constructed of Type 316 stainless steel. Seat washers and gaskets shall be of a material insuring water tightness with a minimum of maintenance. Valves shall be designed for minimum 150 psi water-working pressure, unless otherwise shown.

B. Air-Release Valves: Air-release valves shall vent accumulating air while system is in service and under pressure and be of the size shown and shall meet the same general requirements as specified for air and vacuum valves except that the vacuum feature will not be required. They shall be designed for a minimum water-working pressure of 150 psi, unless otherwise shown.

C. Combination Air Valves: Combination air valves shall combine the characteristics of air and vacuum valves and air release valves by exhausting accumulated air in systems under pressure and releasing or re-admitting large quantities of air while a system is being filled or drained, respectively. They shall have the same general requirements as specified for air and vacuum valves.

D. Sewage Air Release Valves: Sewage air release valves shall vent accumulating gases during system operation. They shall have long float stems and bodies to minimize clogging. The same general requirements shall apply as specified for air and vacuum valves. Each sewage air release valve shall be furnished with the following backwash accessories, fully assembled on the valve:

1. Inlet shut-off valve.
2. Blow-off valve.
3. Clear water inlet valve.
4. Rubber supply hose.
5. Quick disconnect couplings.

E. Manufacturers, or approved equal:

1. APCO (Valve and Primer Corporation)
2. Crispin (Multiplex Manufacturing Company)
3. Val-Matic (Valve and Manufacturing Corporation)
4. GA (Golden-Anderson)

2.09 SMALL PRESSURE REDUCING VALVES (AIR AND WATER)

A. General: Small air and water pressure reducing valves shall be of the spring-loaded diaphragm type with a minimum pressure rating of 250 psi, with bronze body, nickel alloy or stainless steel seat, and threaded ends. Each valve shall be furnished with built-in or separate strainer and union ends.

B. Manufacturers, or approved equal:

1. A.W. Cash Valve Mfg. Corp
2. Fisher Controls Company
3. Mueller Company
4. Watts Regulator Company
5. Wilkins Regulator (A Division of Zurn Industries)

2.10 TEMPERATURE AND PRESSURE RELIEF VALVES

A. Valve Construction: Temperature and pressure relief valves for cold and hot water, and air service, unless otherwise shown or specified, shall have a minimum pressure rating of 250 psi, bronze, steel, or stainless steel bodies, adjustable spring action, screwed or flanged connections, and trim to suit individual applications. They shall be set for each specific condition.

B. Manufacturers, or approved equal:

1. A.W. Cash Valve Mfg. Corp
2. Consolidated (Dresser Industries Valve Division)
3. Fisher Controls Company
4. Masoneilan Control Equipment
5. Mueller Company
6. Watts Regulator Company
7. Wilkins Regulator (A Division of Zurn Industries)

2.11 CORPORATION STOPS

A. Unless otherwise shown, corporation stops shall be made of solid brass for key operation, with screwed ends with corporation thread or iron pipe thread, as required.

B. Manufacturer, or approved equal:

1. Ford Meter Box Company
2. James Jones Company
3. Mueller Company

2.12 SOLENOID VALVES

A. Solenoid valves shall be of the size, type, and class shown and shall be designed for not less than 150 psi water-working pressure. Valves for water, air, or gas service shall have brass or bronze body with screwed ends, stainless steel trim and spring, Teflon or other resilient seals with material best suited for the temperature and fluid handled. Solenoid valves in corrosive environment shall have stainless steel bodies. For chemicals and all corrosive fluids, solenoid valves with Teflon bodies and springs or other suitable materials shall be used. General purpose enclosures for indoors shall be NEMA type 2. For explosion proof, corrosive, special purpose, or outdoor locations NEMA type 4, 7, 8, 9, 9E, 9F, or 9G enclosures shall be used, as applicable. All coil ratings shall be for continuous duty. For electrical characteristics see electrical drawings or specifications.

B. Manufacturers, or approved equal:

1. For general duty:

a. Automatic Switch Co. (ASCO), Model "RED HAT"

b. Skinner Valve Division of Honeywell, Model "LANCER"

c. Magnatrol Valve Corporation

d. J. D. Gould Co

2. For corrosive fluids:

a. Valcor Engineering Corporation

b. +GF+ Plastic Systems, Inc

2.13 FIRE HYDRANTS

A. The Fire Hydrant valve openings shall be five and one-quarter (5-1/4") inch, open left. Nozzle arrangement shall be two (2), two and one half (2-1/2") inch hose connections, National Standard Thread and one (1) four and one half (4-1/2") inch pumper connection, National Standard Thread. Operating nuts shall be one and one half (1-1/2") inch Pentagon.

B. Manufacturers, or approved equal:

1. Mueller Model A-423

2. Kennedy

2.14 ELECTRIC MOTOR OPERATORS (AC REVERSING CONTROL TYPE)

A. Equipment Requirements: Where electric motor operators are shown, an electric motor-operated valve control unit shall be attached to the valve operating mechanism housing by means of a flanged motor adaptor piece.

B. Gearing: The motor operator shall include the motor, reduction gearing, reversing starter, torque switches, and limit switches in a weatherproof NEMA IV assembly. The operator shall be a double reduction unit consisting of spur or helical gears and worm gearing. The spur or helical gears shall be of hardened alloy steel and the worm gear shall be alloy bronze. All gearing shall be accurately cut with hobbing machines. All power gearing shall be grease or oil lubricated, in a sealed housing. Ball or roller bearings shall be used throughout. Operator output speed changes shall be mechanically possible by simply removing the motor and changing the exposed or helical gearset ratio without further disassembly of the electric operator.

C. Starting Device: The unit shall be so designed that a hammer blow is imparted to the stem nut when opening a closed valve or closing an open valve. The device should allow free movement at the stem nut before imparting the hammer blow. The operator motor must attain full speed before stem load is encountered.

D. Switches and Wiring: Travel in the opening and closing directions shall be governed by a switch responsive to mechanical torque developed in seating the valve, or by an obstruction met in opening or closing the valve. The torque switch shall be adjustable and shall function without auxiliary relays or devices. The geared limit switches shall be of the open type and shall be actuated by a rotor cam with 4 contacts to each cam or gear train. The operator shall have a number of gear trains as required to produce the operation shown. The operator shall be wired in accordance with the schematic diagram and all wiring for external connections shall be connected to marked terminals. One 1-inch and one 1-1/4-inch conduit connection shall be provided in the enclosing case.

E. Handwheel Operation: A permanently attached handwheel shall be provided for emergency manual operation. The handwheel shall not rotate during electrical operation. A calibration tag shall be mounted near each switch correlating the dial setting to the unit output torque. Microswitch elements or devices relying on coil springs shall not be used in the torque switches. Position limit switches and associated gearing shall be an integral part of the valve operator. To provide the best possible accuracy and repeatability, limit switch gearing shall be of the "counting" intermittent type, made of stainless steel, grease lubricated, and enclosed in its own gearcase to prevent dirt and foreign matter from entering the gear train. Switches shall not be subject to breakage or slippage due to over travel. Traveling nuts, cams, or microswitch tripping mechanisms shall not be used. Limit switches shall be of the heavy-duty open contact type with rotary wiping action. The maximum torque required on the handwheel under the most adverse conditions specified herein shall not exceed 60 ft-lb, and the maximum force required on the rim of the handwheel shall not exceed 60 lb. An arrow and either the word "open" or "close" shall be cast on the handwheel to indicate the direction to turn said handwheel.

F. Motor: The motor shall be of the totally enclosed, non-ventilated, high-starting torque, low-starting current type for full voltage starting. It shall be suitable for operation on 480-volt, 3-phase, 60-Hz current, and have Class B insulation, and a motor frame with all dimensions in accordance with the latest revised NEMA Standards. The observed temperature rise by thermometer shall not exceed 55 degrees C above an ambient temperature of 40 degrees C when operating continuously for 15 minutes under full rated load. With a line voltage of not more than 10 percent above or 10 percent below the rated voltage, the motor shall develop full rated torque continuously for 15 minutes without causing the thermal contact protective devices, imbedded in the motor windings to trip or the starter overloads to drop out. All bearings shall be of the ball type and thrust bearings shall be provided where necessary. All bearings shall be provided with suitable seals to confine the lubricant and prevent the entrance of dirt and dust. Motor conduit connections shall be watertight. Motor construction shall incorporate the use of stator and rotor as independent components from the valve operation such that the failure of either item shall not require operator disassembly or gearing replacement. The motor shall be furnished with a space heater suitable for operation on 120-volt single-phase circuit.

G. Starter: There shall be furnished and installed in the integral weatherproof housing on the valve, unless otherwise shown, a suitably sized amperage rated reversing starter with its coils rated for operation on 120-volt, 1-phase, 60-Hz current. A control power transformer shall be included to provide a 120-volt source. The starter shall be equipped with 3 overload relays of the automatic reset type. Its control circuit shall be wired as shown. The controls compartment shall contain a suitably sized 120-volt ac single-phased space heater to prevent moisture condensation on electrical components.

H. Operator Appurtenances: The operator for each valve shall be supplied with a 3/2 light push button station with mechanical or electrical lockout device. The pushbutton station enclosure, if separate, shall also be rated for NEMA IV environments.

I. Manufacturers, or Equal:

1. Limitorque Corp.

2. Keystone Valve, Corp.

3. Rotork Corp.

2.15 MANUAL OPERATORS

A. All manual operators shall have levers or handwheels, unless otherwise shown. Where buried, the valves shall have extensions with square nuts or floor stands. Valves mounted higher than 5 feet-6 inches above floor or operating level shall have chain operators. Unless otherwise shown or specified, valves of sizes 4-inch and larger shall have gear-assisted operators.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify Piping System is ready for installation.

3.02 VALVE INSTALLATION

A. General: All valves, gates, operating units, stem extensions, valve boxes, and accessories shall be installed in accordance with the manufacturer's written instructions and as shown and specified. All gates shall be adequately braced to prevent warpage and bending under the intended use. Valves shall be firmly supported to avoid undue stresses on the pipe.

B. Access: All valves shall be installed to provide easy access for operation, removal, and maintenance and to avoid conflicts between valve operators and structural members or handrails.

C. Valve Accessories: Where combinations of valves, sensors, switches, and controls are specified, it shall be the responsibility of the CONTRACTOR to properly assemble and install these various items so that all systems are compatible and operating properly.

The relationship between interrelated items shall be clearly noted on shop drawing submittals.

D. All valves shall be field tested following installation to demonstrate that the valve operates under field conditions in a manner consistent with the design of the system.

E. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

F. Install valves with stems upright or horizontal, not inverted.

G. Install unions downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.

H. All valves installed in plastic pipelines shall be independently supported so as not to cause undue stress or otherwise damage piping.

J. Use all bronze valves for fuel oil service.

K. Diaphragm valves shall be installed in all chlorine solution and chemical feed lines, between the appropriate storage tanks and points of application, and where otherwise shown on the contract drawings.

L. Use 3/4-inch ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment.

3.03 INTERFACE WITH OTHER PRODUCTS

A. Conform to applicable piping specification for hangers and insulation.

END OF SECTION

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SECTION 15140

SUPPORTS AND ANCHORS

PART 1 GENERAL

1.01 WORK INCLUDED

A. Hangers, supports, brackets and anchors.

B. Sleeves and seals.

1.02 REFERENCES

A. ANSI B31.1 Code for Pressure Piping

B. MSS SP-58 Pipe Hangers and Supports - Materials, design and manufacture.

C. MSS SP-69 Pipe Hangers and Supports - Selection and application.

1.04 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Shop Drawings: Submit layout drawings, schematics, and design loading information to demonstrate that support systems that are not as shown on the Drawings are in accordance with the design criteria.

C. Product Data:

1. Include data on materials, fittings and accessories.

2. Include product description, model, dimensions, component sizes, rough-in requirements, service sizes, and finishes.

3. Include dimension drawings indicating components and connections to structures, equipment and piping.

4. Include product performance data.

D. Manufacturer's Installation Instruction: Provide installation details, components assembly and start-up procedures.

1.05 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 01300.

B. Maintenance Data: Include maintenance and inspection data, replacement part numbers and availability.

1.06 QUALITY ASSURANCE

A. Perform work in accordance with State and local regulations.

B. Perform work in accordance with manufacturer's installation instructions.

C. Selection, fabrication, and installation of pipe hangers and supports should conform to the latest requirements of:

l. American National Standards Institute (ANSI) B31.1, Code for Pressure Piping.

2. Manufacturers' Standardization Society (MSS) SP-58. Pipe Hangers and Supports-Materials, Design and Manufacture.

3. Manufacturers' Standardization Society (MSS) SP-69, Pipe Hangers and Supports - Selection and Application.

1.07 REGULATORY REQUIREMENTS

A. Conform to applicable State and local codes for installation.

B. Provide certificate of compliance from authority having jurisdiction indicating approval of installation.

1.08 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 1600.

B. Accept equipment on site in shipping containers with labeling in place. Inspect for damage.

C. Protect equipment and elements from damage by maintaining shipping packaging in place until installation.

1.09 WARRANTY

A. Provide warranty under provisions of Section 1700.

1.10 MAINTENANCE SERVICE

A. Furnish service and maintenance for one year from Date of Substantial Completion.

1.11 DESIGN CRITERIA

A. General:

1. Piping 6 Inches and Larger: Pipe supports are shown on the Drawings for piping 6 inches and larger in diameter, where the piping is shown on layout drawings. The location and types of supports and braces are indicative and may be modified by the Contractor to suit field conditions, provided the modified support system conforms to the design criteria stated herein, and receives the favorable review. Where piping is shown schematically only, it shall be the Contractor's responsibility to support all such piping in accordance with the

design criteria stated herein and using support details shown on the Drawings. Pipe supports have been designed assuming flanged joints on ductile iron pipe and steel pipe, unless otherwise indicated on the Drawings. If groove type mechanical couplings are used as an alternative, provide additional supports where required, particularly to resist rotation. Shop drawings of these additional supports shall be favorably reviewed by the Engineer prior to installation.

2. Piping Less Than 6 Inches: Pipe supports are generally not shown for piping less than 6 inches in diameter. Where supports are not shown, it shall be the Contractor's responsibility to support all such piping in accordance with the design criteria stated hereinafter and the support details shown on the Drawings. Piping 2-1/2 inches and larger and all piping for hazardous chemicals shall be supported with pipe supports designed to resist seismic loads, as indicated on the pipe support details. Hazardous chemical piping includes ferric chloride and spare (future chemical).

3. Where not detailed or otherwise indicated, pipe support types and spacing shall be in accordance with the Manufacturer's Standardization Society (MSS) Standard Practice No. SP-58 and No. SP-69, except as superseded by the requirements of these Specifications. Submit Drawings of pipe supports that are not as detailed on the Drawings.

B. Pipe Support System Design:

1. Design Loads: Pipe suspension shall be such as to prevent excessive stress or excessive variation in supporting force while system is in operation. Pipe supports shall support the sum of the weight of the pipe, fittings, appurtenances, and contents. In addition, the pipe shall be anchored to resist internal pressure forces tending to separate any unrestrained joint at pressures 1-1/2 times the maximum working pressure for the applicable service.

2. Location: All piping shall be supported in a manner, which will prevent undue strain on any valve, fitting, or piece of equipment. In addition, pipe supports shall be provided at changes in direction or elevation, adjacent to flexible couplings, at all nonrigid joints, at hose bibs, and where otherwise shown. Where piping connects equipment, it shall be supported by a pipe support and not by the equipment.

    a. Maximum support spacing shall conform to the following table:

Pipe Size Inches	Pipe Material	Maximum Spacing (Feet)
1" & Smaller	Iron or Steel	6
	Copper	4 ½
	Plastic	Continuous
	Tubing	Continuous
1-1/4” to 2"	Iron or Steel	8
	Copper or Plastic	5
2-1/2” to 4”	Iron or Steel	10
	Copper or Plastic	6
6” to 8”	Iron or Steel	12
	Copper or Plastic	8
10” or Larger	Iron or Steel	15

3. Anchors: Anchors for connecting pipe supports to concrete shall be in accordance with Section 05500.

4. Thermal Expansion Allowance:

   a. Provide one rigid pipe support for each straight run of pipe and between each pair of flexible couplings, flexible connectors, or expansion loops for pipes listed below. PVC pipe larger than 1-inch in diameter shall allow sliding inside PVC sleeve, along the pipe axis.

   b. Provide vertical supports only, that is, no lateral support, within 4 feet of an angle or tee for pipes listed above.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. B-Line Systems, Inc.

509 West Monroe Street

Highland, Illinois 62249-0326

(6l8) 654-2l84

B. ITT Grinnell Corporation

Erie Avenue and D Street

Philadelphia, Pennsylvania 19134

(2l5) 425-5850

C. Thunderline Corporation

8707 Samuel Barton Drive

Belleville, Michigan 48111

(3l3) 397-5000

D. Substitutions: Under provisions of Section 01300.

2.02 PIPE SUPPORTS

A. Manufacture and Design: Pipe supports shall to the maximum extent possible be standard factory fabricated units conforming to the typical supports and braces shown in the Drawings and as specified below. Where required support cannot be provided by standard factory fabricated units, and is not detailed on the Drawings, the Contractor shall provide special pipe supports. Supports shall be manufactured or special fabrications or combination as shown on the Drawings or specified. Special fabrications shall be in conformance with Section 05500. Provide ¾-inch chamfer on corners of all support elements and file or grind smooth. Supports designated to allow axial pipe movement shall have smooth and even contact surfaces.

B. Materials: All support systems shall be galvanized steel except that those that are submerged or that are located within a tank, channel, or other structure designed to hold water or tank wall top, or otherwise called out on the Drawings, shall be Type 304 stainless steel. Trays for continuous support of plastic pipe or tubing shall be made of 20-gauge galvanized steel.

C. Insulation Protection Shields: Provide insulation protection shields at all pipe supports for insulated piping.

D. Provide plastic caps with rounded corners on all exposed ends of channels.

2.03 FIBERGLASS SUPPORTS

A. Manufacture and Design: Pipe supports shall to the maximum extent possible be standard factory fabricated units conforming to the typical supports and braces shown on the Drawings and as specified above.

B. Acceptable manufacturers for the Fiberglass Supports are:

1. Aickinstrut manufactured by Allied Support Systems
2. Omnisystem manufactured by Champion Fiberglass Systems
3. Approved equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. All pipe hangers and supports shall allow for the expansion and contraction of the piping system.

B. The piping system shall have anchors, guides and supports so that the stress range is not excessive for the anticipated cycles of operation.

C. Pipe hanger loads are to be determined by accurate weight balance calculations to prevent the transfer of loads to equipment or terminal connections.

D. Support the piping system by using standard manufactured hangers and supports wherever possible.

E. All pipe hangers and supports shall have 1-1/2 inch minimum adjustment available after installation.

F. Hanger rods shall be subjected to tension only and must not exceed four-degrees of vertical angle. Lateral and axial movement shall be accommodated by proper linkage in the rod assembly.

G. Horizontal piping with a centerline elevation of less than 4 feet shall be supported from the floor.

H. Wall brackets shall be used to suspend or support pipe runs near a wall.

I. Use pipe clamps where flexibility in the hanger assembly is required due to horizontal pipe movement. For non-insulated pipe, use standard pipe clamps.

J. Vertical pipe runs shall be supported independently of any connected horizontal pipe. Use riser clamps to support the weight of the pipe.

K. Supplemental steel shall be designed per AISC Steel Construction Manual and Local Building Codes.

L. Coordinate placement of pipe support system with other work.

M. Install pipe support system in accordance with manufacturer's instructions.

N. Install pipe support system not to interfere with use of space or other work.

O. Do not hang piping from other piping.

P. Support underground piping per details on accompanying drawings.

Q. Provide thrust blocking for underground piping per details on accompanying drawings.

R. Provide support at all concentrated loads such as valves, risers, etc.

S. Coordinate placement of sleeves and seals with other work.

T. Install sleeves and seals in accordance with manufacturer's instructions.

U. Contractor shall determine the required inside diameter of each individual wall opening or sleeve before ordering, fabricating or installing. The inside diameter of each wall opening shall be sized as recommended by the manufacturer to fit the pipe and seal to assure a watertight joint. Sizing (correct seal model and number of links per seal) may be obtained through manufacturer's catalog. If pipe O.D. is non-standard due to coating, insulation, etc., consult factory for engineering assistance and recommendation before proceeding with wall opening detail.

V. Place a hanger within 12 inches of each horizontal elbow.

W. Design hangers to provide assembly without disengagement of supported pipe.

X. Electrolytic Protection: Pipe supports serving copper pipe or tubing shall be dielectrically insulated from the pipe by dielectric sleeves or plastic pipe wrap at the point of contact.

END OF SECTION

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SECTION 15190

MECHANICAL IDENTIFICATION

PART 1 GENERAL

1.01 WORK INCLUDED

A. Identification of mechanical equipment and piping installed.

1.02 REFERENCES

A. ANSI/ASME A13.1 - Scheme for the Identification of Piping Systems.

1.03 SUBMITTALS

A. Submit product data under provisions of Section 01300.

B. Submit list of wording, symbols, letter size, and color-coding for mechanical identification.

C. Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

D. Submit manufacturer's installation instructions under provisions of Section 01300.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Seton Name Plate Company.

B. Allen Systems.

C. Substitutions: Under provisions of Section 01300.

2.02 MATERIALS

A. Color: Unless specified otherwise, conform with ANSI/ASME A13.1.

B. Plastic Nameplates: Laminated three-layer plastic with engraved black letters on light contrasting background color.

C. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.

D. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and fluid being conveyed.

E. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape of not less than 6 inch wide by 4 mil thick, manufactured for direct burial service. .

PART 3 EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive identification materials.

3.02 INSTALLATION

A. Plastic Nameplates: Install with corrosive-resistant mechanical fasteners, or adhesive.

B. Plastic Tags: Install with corrosive-resistant chain.

C. Plastic Pipe Markers: Install in accordance with manufacturer's instructions.

D. Underground Plastic Pipe Markers: Install around buried pipe.

E. Equipment: Identify stainers, filter, compressor, pumps, tanks, and water treatment devices with plastic nameplates. Small devices may be identified with plastic tags.

F. Controls: Identify control panels and major control components outside panels with plastic nameplates.

G. Valves: Identify valves in main and branch piping with tags.

H. Visibility: Attention shall be given to visibility with reference to pipe markings. Where pipe lines are located above or below the normal line of vision, the lettering shall be placed below or above the horizontal centerline of the pipe.

I. Unusual or Extreme Situations: When the piping layout creates or occurs in a limited area of inaccessibility or of extreme complexity, such segments of layouts may require substitute techniques to achieve positive identification. Use of substitute techniques shall be limited to such segments, shall not deviate from the concept of identification described above and shall be approved prior to installation.

3.03 PIPE MARKERS

A. Pipe Markers shall be applied where piping enters or leaves the wall or floor of a structure, adjacent to tanks or other hydraulic containments, at each valve, at each piping change in direction, and shall be applied along piping runs not exceeding 16 feet on center.

B. Directional Arrows: Point in the direction of flow.

C. Locate pipe markers for easy reading. Where pipes are located above normal line of vision, the lettering and directional arrows shall be placed below the horizontal centerline of the pipe. Where pipes are below normal line of vision, lettering and directional arrows shall be above the horizontal centerline of the pipe.

3.04 VALVE CHART AND SCHEDULE

A. Provide valve chart and schedule in aluminum frame with clear plastic shield. Install at location as directed.

END OF SECTION

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SECTION 15375

GLASS-COATED, BOLTED-STEEL POTABLE WATER STORAGE TANK

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish and erect a glass-coated, bolted-steel water storage tank, including foundation, tank structure and tank appurtenances for a complete installation as shown of the Contract Drawings and described herein.

B. All required labor, testing, materials and equipment shall be supplied and installed by the tank bidder.

1.02 PRE-QUALIFICATIONS OF TANK MANUFACTURER AND ERECTOR

A. The Engineer's selection of factory applied glass-fused-to-steel bolt together tank construction has been predicated upon the design criteria, construction methods specified, and optimum coating for resistance to internal and external tank surface corrosion. Deviations from the specified design, manufacturer, erection, or coating details, will not be permitted.

B. The bidder will offer a new tank structure designed and produced in the United States of America by a manufacturer specializing in the design, fabrication and erection of factory applied glass-fused-to-steel, bolt together tank systems. All steel used in the tank structure will be smelted and produced in the United States of America.

C. The manufacturers who will be considered as meeting the requirements of this specification are: A.O. Smith Harvestore Product, Inc. of Dekalb, Illinois; or pre-approved equal.

D. Any other tank construction contractor wishing to be considered will submit a written record of their experience in the design and construction of the type of tank and foundation proposed for this project including a list of ten (10) potable water storage tanks of like size or larger presently in service in the United States of America for a minimum of five years. The reference list will include the name and telephone number of the Owner and Engineer. Other information to be submitted for pre-qualification review will include:

1) typical tank structure and foundation drawings

2) specifications for tank shell, appurtenance and coating

E. Qualification data shall be submitted to the Engineer for his consideration at least 15 days prior to the date set for the receipt of bids if bids are solicited. Any tank construction contractor considered acceptable for this Project will be notified by registered letter by the Engineer. The contractor shall list on his bid proposal and/or

subcontractor listing only such tank companies that are listed above, or that have received a letter of qualification from the Engineer. Bids from other companies will not be considered.

F. Strict adherence to the standards of design, fabrication, erection, product quality, and long term (30 year minimum) performance, established in this specification will be required by the Owner and Engineer.

G. The Engineer and Owner will analyze and evaluate all bids based on 30 year (minimum) operation and maintenance costs, operational flexibility, and other considerations. Values to be used in this evaluation will be at the discretion of the Engineer.

1.03 SUBMITTAL DRAWINGS AND SPECIFICATIONS

A. Construction shall be governed by the Drawings and Specifications showing general dimensions and construction details, after written approval by the Engineer of detailed erection drawings prepared by the tank bidder. There shall be no deviation from the Drawings or Specifications, except upon written order from the Engineer.

B. Geotechnical Analyses: Submit Geotechnical Analyses performed by a soil laboratory. Contractor shall provide laboratory one representative sample of on-site subsoil where the tank is to be constructed.

C. The bidder is required to furnish, for the approval of the Engineer and at no increase in contract price 6 sets of complete specifications and construction drawings for all Work of this Section. A complete set of structural calculations shall be provided for the tank structure and foundation. All such submissions shall be stamped by Registered Professional Engineer in the State of Pennsylvania who is a full-time employee of the tank manufacturer’s engineering staff.

D. When approved, two sets of such prints and submittal information will be returned to the bidder marked with Engineer’s approval, and these drawings will then govern for the Work detailed thereon. The approval by the Engineer of the tank supplier's drawings shall be an approval relating only to their general conformity with the Drawings and Specifications and shall not guarantee detail dimensions and quantities.

E. The tank manufacturer's standard published warranty shall be included with submittal information.

1.04 WARRANTY

A STRUCTURE

1. If within a period of two (2) years from date of completion the water storage tank, or any part thereof, shall prove to be defective in material or workmanship upon examination by the manufacturer, the manufacturer will supply an identical or substantially similar replacement part or the manufacturer, at its option, will repair or allow credit for such part.

2. If within a period of five (5) years from date of completion of the tank (but not more than 62 months from date of delivery of the product to the erection site) the coating on the tank chips, cracks, spalls, or under-cuts during normal water service, the manufacturer shall (after examination by the manufacturer) supply and identical or substantially similar replacement part or the manufacturer, at its option, will repair or allow credit for such part.

1.05 STATE LOCAL AND FEDERAL REQUIREMENTS

A. All requirements for safety and water supply of the State local and Federal governments shall be met except when they are exceeded by the Township's standards.

PART 2 PRODUCTS

2.01 DESIGN CRITERIA

A. Tank Size

1. The factory coated glass-fused-to-steel, bolt together tank shall a nominal diameter and sidewall height (to roof eave) as shown on the Drawings. A minimum usable storage capacity of one days peak daily flow plus fire flow must be provided.

B. Tank Capacity

1. Tank capacity shall be as shown on the plans or to provide the minimum storage (nominal, U.S. gallons). The usable capacity of the tank, if it is a gravity system, should be only considered usable only if it can supply a minimum of 30 psi to the highest dwelling on the site (at a point 14' above the first floor elevation).

C. Foundation

1. Finished floor elevation shall be as shown on the Drawings. Foundations and floors shall be of reinforced concrete with an embedded starter ring per the manufacturer's design. Test borings and a foundation analysis shall be provided as part of the design.

D. Tank Design Standards

1. The materials, design, fabrication, and erection of the bolt together tank shall conform to the American Water Works Association standard for "Factory Coated Bolted Steel Tanks for Water Storage" ANSI/AWWA D103-87, seismic zone 1 or 2, fixed percentage method.

2. The tank coating system shall conform solely to Section 10.4 of ANSI/AWWA D103-87.

3. The roof shall be constructed of the same material as the sidewalls and shall be provided by the tank manufacturer. Manufacturer supplied roof vent and access hatch shall be provided. (see 3.04 to 3.06)

4. An outside ladder shall be provided with a safety cage and step-off platforms. It shall be of galvanized steel and supplied by the manufacturer. (see 3.04 to 3.06)

E. Design Loads

1.	Specific Gravity	1.0
2.	Wind Force	100 MPH
3.	Shape factor	0.6
4.	Soil bearing capacity	2,500 PSF*
5.	Roof live load	30 PSF
6.	Earthquake Seismic Zone	1

- or greater as determined by geotechnical analysis

F. Location

1. All water storage facilities shall be located to provide maximum pressure to the (new) development and to allow for being connected to the Township's distribution system if possible.

G. Access

1. All storage tanks shall be accessible by a service truck, sufficient space for parking and maneuvering next to the tank shall be provided and it shall be paved.

2.03 MATERIAL SPECIFICATIONS

A. Plates and Sheets

1. Plates and sheets used in the construction of the tank shell, tank floor (optional) or tank roof (optional), shall comply with the minimum standards of AWWA D103, Section 2.4.

2. Design requirements for mild strength steel shall be ASTM A570 Grade 30 with a maximum allowable tensile stress of 15,000 psi.

3. Design requirements for high strength steel shall be ASTM A607 Grade 50 with a maximum allowable tensile stress of 26,000 psi.

4. The annealing effect created from the glass coated firing process shall be considered in determining ultimate steel strength. In no event shall yield strength greater than 50,000 psi be utilized for calculations detailed in AWWA D103, Sections 3.4 and 3.5.

5. Multiple vertical bolt line sheets and plates of ASTM A607 Grade 50 only shall be manufactured such that holes are staggered in the vertical bolt lines and that no two adjoining holes are in-line horizontally, except at the center of the sheet or plate.

6. Sheet edges of sidewall and floor plates shall be mechanically removed and coated with a corrosion resistant material prior to glass coating so as to ensure glass coating of the sheet edges. The process shall be equal to EDGECOAT™ by A. O. Smith Harvestore Products, Inc.

B. Rolled Structural Shapes

1. Material shall conform to minimum standards of ASTM A36 or AISI 1010.

C. Horizontal Wind Stiffeners

1. Design requirements for intermediate horizontal wind stiffeners shall be of the "web truss" design with extended tail to create multiple layers of stiffener, permitting wind load to transfer around tank.

2. Web truss stiffeners shall be of steel with hot dipped galvanized coating.

3. Rolled steel angle stiffeners are not permitted for intermediate stiffeners.

D. Bolt Fasteners

1. Bolts used in tank lap joints shall be 1/2" - 13 UNC- 2A rolled thread, and shall meet the minimum requirements of AWWA D103, Section 2.2.

2. Bolt Material

   a. SAE Grade 2

   b. Tensile Strength - 74,000 psi Min.

   c. Proof Load - 55,000 psi Min.

   d. Allowable shear stress - 18,164 psi (AWWA D103).

3. SAE grade 8/ASTM A325 heat treated to:

   a. Tensile Strength - 150,000 psi Min.

   b. Proof Load - 120,000 psi Min.

   c. Allowable shear stress - 36,818 psi (AWWA D103).

4. Bolt Finish - Zinc, mechanically deposited.

   a. 2.0 mils minimum - under bolt head, on shank and threads

5. Bolt Head Encapsulation

   a. High impact polypropylene co-polymer encapsulation of entire bolt head up to the splines on the shank.

   b. Natural resin only.

6. All tank shell bolts shall be installed such that the head portion is located inside the tank, and the washer and nut are on the exterior.

7. All lap joint bolts shall be properly selected such that threaded portions will not be exposed in the "shear plane" between tank sheets. Also, bolt lengths shall be sized as to achieve a neat and uniform appearance. Excessive threads extending beyond the nut after torquing will not be permitted.

8. All lap joint bolts shall include a minimum of four (4) splines on the underside of the bolt head at the shank in order to resist rotation during torquing.

E. Sealants

1. The lap joint sealant shall be a one component, moisture cured, polyurethane compound. The sealant shall be suitable for contact with potable water and meet applicable FDA Title 21 regulations, as well as, ANSI/NSF Additives Standard 61.

2. The sealant shall be used to seal lap joints, bolt connections and sheet edges. The sealant shall cure to a rubber like consistency, have excellent adhesion to the glass coating, have low shrinkage, and be suitable for interior and exterior exposure.

3. Sealant curing rate at 73°F and 50% RH

   a. Tack-free time: 6 to 8 hours.

   b. Final cure time: 10 to 12 days.

4. The sealant shall be Harvestore Products, Inc. System Sealer No. 79.

5. Neoprene gaskets and tape type sealer shall not be used.

2.04 GLASS COATING SPECIFICATION

A. Surface Preparation

1. Following the decoiling and shearing process, sheets shall be steel grit-blasted on both sides to the equivalent of SSPC-10. Sand blasting and chemical pickling of steel sheets is not acceptable.

2. The surface anchor pattern shall be not less than 1.0 mil.

3. These sheets shall be evenly oiled on both sides to protect them from corrosion during fabrication.

B Cleaning

1. After fabrication and prior to application of the coating system, all sheets shall be thoroughly cleaned by a caustic wash and hot rinse process followed immediately by hot air drying.

2. Inspection of the sheets shall be made for traces of foreign matter or rust. Any such sheets shall be recleaned or grit-blasted to an acceptable level of quality.

C. Coating

1. All sheets shall be primed with catalytic nickel oxide glass ground-coat on both sides, and then air-dried per section 10.4.2.1 of AWWA D103.

2. An intermediate coat to both sides of the sheets, of cobalt blue glass frit, shall be made.

3. The sheets shall then be fired at a minimum temperature of 1500 °F in strict accordance with the manufacturer's quality process control procedures, including firing time, furnace humidity, temperature control, etc.

4. Fired sheets shall receive a final coat of titanium dioxide enhanced silica glass coating on the interior surface, then refired in the furnace.

5. Dry film coating thickness shall be 10.0 -16.0 mils.

6. The finished tank color shall be sky blue.

D. Inspection

1. All coated sheets shall be inspected for mil thickness (Mikrotest or equal).

2. All coated sheets shall be checked for color uniformity by an electronic colorimeter.

3. An electrical leak detection test shall be performed on the inside surface after fabrication of the sheet. Sheets with excessive electrical leakers shall be rejected so as to minimize field touch up (See 3.03 E).

E Packaging

1. All approved sheets shall be protected from damage prior to packing for shipment.

2. Heavy paper or plastic foam sheets shall be placed between each panel to eliminate sheet-to-sheet abrasion during shipment.

3. Individual stacks of panels will be wrapped in heavy mil black plastic and steel banded to special wood pallets built to the roll-radius of the tank panels. This procedure eliminates contact or movement of finished panels during shipment.

4. Shipment from the factory to the job site will be by truck, hauling the tank components exclusively.

PART 3 EXECUTION

3.01 FOUNDATION

A. The tank foundation is part of this Contract, and shall be installed by the tank bidder.

B. The tank foundation shall be designed by the manufacturer to safely sustain the structure and its live loads.

C. Tank footing design shall be based on 2500 PSF soil bearing capacity or greater as determined by geotechnical analysis performed by a licensed soil Engineer. The cost of this investigation and analysis shall be included in the bid price. A copy of the soils report shall be provided to the Owner or Engineer.

3.02 FLOOR

A. The floor shall be glass-coated, bolted steel. Bolted steel panels shall be placed on a non-extruding and resilient bituminous type floor meeting the requirements of ASTM D1751 when set on a concrete slab.

B. Polyethylene co-polymer caps and sealant shall be used to cover all bolts, nuts and washers which shall be exposed on the inside of floor.

C. Leveling of the starter ring shall be required and the maximum differential elevation within the ring shall not exceed one-eighth (1/8") inch, nor exceed one-sixteenth (1/16") inch within any ten (10ft) feet of length.

3.03 SIDEWALL STRUCTURE

A. Field erection of the glass-coated, bolted-steel tank shall be in strict accordance with the procedures established by the manufacturer and performed by an authorized dealer of the manufacturer regularly engaged in erection of these tanks.

B. Specialized erection jacks and building equipment developed and supplied by the tank manufacturer shall be used to erect the tanks.

C. Particular care shall be taken in handling and bolting of the tank panels and members to avoid abrasion of the coating system. Prior to liquid tests, all surface areas shall be visually inspected by the Engineer.

D. The placement of sealant on each panel may be inspected prior to placement of adjacent panels. However, the Engineer's inspection shall not relieve the bidder from his responsibility for liquid tightness.

E. An electrical leak test shall be performed during erection using a nine (9) volt leak detection device. All electrical leak points found on the inside surface shall be repaired in accordance with manufacturer's published touch up procedure.

F. No backfill is to be placed against the sidewall unless prior written approval, shell design, and backfill procedures have been provided by the tank manufacturer.

3.04 ROOF

A. The roof shall be a radically sectioned roof fabricated from glass-coated, bolted-steel panels, similar to the tank sheets, as produced by the tank manufacturer, and shall be assembled in a similar manner as the sidewall panels utilizing the same sealant and bolting techniques, so as to assure a water/air tight assembly. The roof shall be clear span and self-supporting. Both live and dead loads shall be carried by the tank walls. The manufacturer shall furnish a roof opening which shall be placed near the outside tank ladder and which shall be provided with a hinged cover and a hasp for locking. The opening shall have a clear dimension of at least twenty-four (24) inches in one direction and fifteen (15) inches in the other direction. The opening shall have a curb at least four (4) inches in height, and the cover shall have a downward overlap of at least two (2) inches, or a gasketed weather-tight cover in lieu of the four (4) inches curb and two (2) inch overlap.

B. The finished color shall be white.

3.05 ROOF VENT

A. A properly sized vent assembly in accordance with AWWA D103-87, or latest revision shall be furnished and installed above the maximum water level of sufficient capacity so that at maximum possible rate of water fill or withdrawal, the resulting interior pressure or vacuum will not exceed one half inch (1/2 inch) water column.

B. The overflow pipe shall not be considered to be a tank vent.

C. The vent shall be constructed of aluminum.

D. The vent shall be so designed in construction as to prevent the entrance of birds or animals by including an expanded aluminum screen with 1/2 inch opening and an insect screen of 23 to 25 mesh polyester monofilament.

3.06 APPURTENANCES (per AWWA D103-87, Section 5)

A. Pipe Connection

1. Where pipe connections are shown to pass through tank panels, they shall be field located, saw cut, (acetylene torch cutting or welding is not permitted), and utilize an interior and exterior flange assembly. Harvestore Systems Sealer No.79 or equal shall be applied on any cut panel edges or bolt connection.

2. Overflow piping shall be 6 inch diameter schedule 80 PVC.

B. Outside Tank Ladder

1. An outside tank ladder shall be furnished and installed as shown on the drawings.

2. Ladders shall be fabricated of aluminum and utilize grooved, skid resistant rungs.

3. Safety cage and step-off platforms shall be fabricated of galvanized steel.

C. Access Door

1. One access door shall be provided as standard per AWWA D103-87.

2. The door shall be minimum of 24 inches diameter, shall include a properly designed reinforcing frame and cover plate.

D. Identification Plate

1. A manufacturer's nameplate shall list the tank serial number, tank diameter and height, maximum design capacity, intended storage use, and date of installation. The nameplate shall be affixed to the tank exterior sidewall at a location approximately five (5) feet from grade elevation in a position of unobstructed view.

3.07 FIELD TESTING

A. Hydrostatic

1. Following completion of erection and cleaning of the tank, the structure shall be tested for liquid tightness by filling to its overflow elevation.

2. Any leaks disclosed by this test shall be corrected by the erector in accordance with the manufacturer's recommendations.

3. Water required for testing may be furnished by the Owner at the time of tank erection completion if available. Contractor is responsible for obtaining water from a source approved by Engineer.

4. Labor and equipment for tank testing is to be included in the price of the tank.

3.07 DISINFECTION

A. Standards

1. The tank structure shall be disinfected at the time of testing by chlorination in accordance with AWWA specification C652, latest revision, "Disinfection of Water Storage Facilities".

2. Disinfection shall not take place until the tank sealant is fully cured (5 to 8 days at 73 degrees F and 50% relative humidity or equivalent).

3. Acceptable forms of chlorine for disinfection shall be:

a. Liquid chlorine (section 3.1 AWWA C652-86)

b. Sodium hypochlorite (section 3.2 AWWA C652-86)

c. Unacceptable forms of chlorine for disinfection are:

i. Calcium hypochlorite (HTH brand chlorine)

4. Acceptable forms of chlorination per AWWA C652-86

a. Section 4.1.1

b. Section 4.1.2.1

c. Section 4.3

5. Unacceptable methods of chlorination per AWWA C652-86

a. Section 4.2

6. Bacteriological testing of the potable water shall be the responsibility of the Owner. However, Contractor is responsible for providing sanitary conditions that guarantee passing bacterial tests (zero coliform bacteria and < 5 heterotrophic bacteria per 100 ml. Contractor shall disinfect until passing test results are obtained.

3.08 ONE YEAR INSPECTION

A. On or near the one year anniversary date of initial tank use the manufacturer's authorized dealer shall make a visual inspection of the tank interior coating and appurtenances; tank exterior coating and appurtenances; and the immediate area surrounding the tank. A written summary of this inspection will be filed with the tank owner and the tank manufacturer.

END OF SECTION

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SECTION 15380

HYDROPNEUMATIC TANKS

PART 1 GENERAL

1.01 CERTIFICATION/GENERAL

A. Tank shall have ASME certification and labeling.

B. All requirements for safety and water supply of the State local and Federal governments shall be met except when they are exceeded by the Township's standards.

1.02 CONSTRUCTION

A. The tank shall be of cylindrical shape and all welded construction. The tank shall be designed for an internal working pressure of 150 pounds per square inch.

B. Tank material, general design and welds shall be in accordance with AWWA specification D100 Sections 2,3,8 and 9, respectively, and ASME Unified Pressure Vessel Code. The tank shall be supplied by Buffalo Tank Co. or approved equal.

C. The tank shall be provided with connections for a level control probe, site gauges, a safety valve, an air line from the air compressor, a drain in the bottom, an outlet to the tank pressure control, a manhole, a flanged inlet, and a flanged outlet. Multiple tanks must each be fully isolatable for testing or replacement.

1.03 ACCESSORIES

A. Two shielded sight glasses shall be provided and installed on the hydropneumatic tank. Each shall be 36" long and have 1/2" valves at each end and a bleeder valve at the lower end.

B. A pressure relief valve shall be provided and installed on the hydropneumatic tank. It shall be manufactured by Crane Company. The valve shall be set for a pressure of 160 psi or less, if required by the tank manufacturer.

C. A pressure gauge of suitable calibration shall be installed on the hydropneumatic tank.

1.03 PAINTING & CORROSION PROTECTION

A. The tank shall be painted in accordance with Section 1.04 of specification 15381

1.05 TESTING

A. After the tank has been set in place and connected it shall be filled two-thirds full and tested at working pressure of 150 psi with all valves closed. The tank shall not lose more than one-half pound pressure in 24 hours.

B. Any leaks, which are disclosed by this test, shall be repaired by gouging out defective areas and rewelding by an ASME qualified welder. Any paint damage by repairs shall be properly restored. The tank shall be retested and the Contractor shall be responsible for any additional test water required.

1.06 DISINFECTION

A. Disinfection shall be accomplished as required by Section 15400, Part 14 of these specifications.

1.07 HYDROPNEUMATIC SYSTEM CONTROL

A. System Description: Combination pressure tank control for operating duplex domestic water pumps and an air compressor to accurately and automatically maintain the correct air/water ratio in the tank at all times. The system shall consist of the following:

1. A separate level probe, which attaches to the tank such that it detects when the tank is 40 percent full.

2. Independent and adjustable pressure sensor for each pump start point, for air control, and low-pressure alarm. Each pressure sensor shall be easily adjustable over an operating range of 30 to 85 psig. Each shall consist of a bellows operated mercury switch.

3. Separate contacts for each of the pressure sensors for remove wiring to starters and the alarm.

4. A NEMA 4 enclosure for wall mounting.

5. A 4-1/2 inch pressure gauge calibrated 0-100 psig mounted on the enclosure door and connected to the pneumatic tubing to read system pressure.

6. Manual shut-off and bleed valves mounted inside the enclosure for calibration.

7. An oil-less type, floor mounted air compressor capable of supplying the required quantity of air at 100 psig continuously.

B. System Operation: The system shall accurately and automatically maintain the correct air/water ratio in the tank by operating the pumps at the desired pressure setting and then stopping them at the high water level as indicated by the separate probe. Control shall automatically rebalance the air pressure by operating the air compressor, and adding air.

C. The Control System shall be supplied by Autocon Industries.

END OF SECTION

SECTION 15381

INTERIOR NON-PRESSURE WATER STORAGE TANKS

PART 1 GENERAL

1.01 GENERAL/MANUFACTURER

A. Materials, design, shop fabrication, welding, erection, inspection, testing, painting, and disinfection of the tank and appurtenances shall be in compliance with the latest revision of the American Water Works Association Standard Specification AWWA D-100 for "Welded Steel Tanks for Water Storage".

B. The tank shall be supplied and erected by Fisher Tank Company, 3131 W. Fourth Street, Chester, PA 19013, or approved equal.

C. All portion of the structure in contact with the water shall have a minimum thickness of 1/4" and the minimum thickness of parts not in contact with the water shall be 3/16".

D. The roof shall be a self-supporting umbrella watertight style.

E. All requirements for safety and water supply of the State local and Federal governments shall be met except when they are exceeded by the Township's standards.

1.02 FOUNDATION

A. Detail foundation plans must be provided with the approval of the tank company. All necessary data regarding soil conditions at the erection site, including the safe bearing value of the soil at a given depth below existing grade at the site must be provided.

1.03 ACCESSORIES

GENERAL

A. Accessory equipment in accordance with Section 6 of the AWWA Specification D-100 shall be provided as follows:

B. A suitable vent at or near the center of the tank roof of adequate size to safely vent the tank when pumping or withdrawing water at its maximum rate shall be provided.

C. A 24" diameter access manhole in roof, equipped with hinged cover and provision for locking device shall be provided.

D. Provide an outside shell ladder from a point approximately 8 feet above top of foundation to the roof. The ladder is to be equipped with a safety cage and belt track and comply with OSHA requirements.

E. The overflow pipe shall extend down the outside of the tank shell and shall discharge to an appropriate exterior location.

F. A circular manhole 24-in. diameter with cover hinged to the shell shall be furnished in the first ring of the tank at the location shown on the plans.

G. A steel inlet pipe with base elbow and riser shall be provided. The inlet pipe shall be welded to the tank bottom. The foundation contractor shall furnish and install the base elbow and inlet piping with the welded connection to the tank made by the tank contractor.

H. A steel outlet pipe with base elbow shall be provided. The outlet pipe shall be welded to the tank bottom, flush with the bottom, and be equipped with a removable silt stop. The foundation contractor shall furnish and install the base elbow and outlet piping with the welded connection to the tank made by the tank contractor.

I. Furnish and install a roof ladder to provide access to the center of the roof.

J. After completion of erection, the tank contractor shall grout between the concrete foundation and the tank bottom with a sand-cement grout with AWWA Specifications.

1.04 CLEANING AND PAINTING

A. All painting shall be done at such times as approved by the Engineer and shall be done in strict accordance with the supplier's instructions and shall be performed in a manner satisfactory to the Engineer.

B. All painting systems shall comply with the requirements of AWWA D-102, except as hereinafter modified.

C. The paints and the paint products shall be supplied by Pennsbury Coatings Corp., New Britain, PA or approved equal.

D. All materials shall be brought to the job site in the original sealed and labeled containers of the paint manufacturer, and shall be subject to inspection by the Engineer on the job. Colors, where not specified, shall be as selected by the Township.

E. The Contractor shall submit to the Engineer, immediately upon completion of the job, certification from the supplier indicating that the quantity of each coating purchased was sufficient to properly coat all surfaces. Such certification shall make reference to the square footage figures provided to the supplier and the Engineer by the Contractor.

F. The Contractor shall apply each coating at the rate and in the manner specified by the supplier. If material has thickened or must be diluted for application by spray gun, the coating shall be built up to the same film thickness achieved with the undiluted material.

G. Deficiencies in film thickness shall be corrected by the application of an additional coat(s) of paint. Where thinning is necessary, only the products of the supplier furnishing the paint, and for that particular purpose, shall be allowed. All thinning shall be done strictly in accordance with the supplier's instructions, as well as with the full knowledge and approval of the Engineer.

H. No paint shall be applied when the surrounding air temperature, as measured in the shade, is below 40 degrees F. No paint shall be applied when the temperature of the surface to be painted is below 35 degrees F. Paint shall not be applied to wet or damp surfaces, and shall not be applied in rain, snow, fog or mist, or when the relative humidity exceeds 85%. No paint shall be applied when it is expected that the relative humidity will exceed 85% or that the air temperature will drop below 40 degrees F., within 18 hours after the application of

the paint. Dew or moisture condensation should be anticipated, and if such conditions are prevalent, painting shall be delayed until midmorning to be certain that the surfaces are dry. Further, the day's painting should be completed well in advance of the probable time of day when condensation will occur, in order to permit the film an appreciable drying time prior to the formation of moisture.

I. Contractor shall provide adequate air exhaust equipment to eject sandblast dust and solvent fumes from tank interior to prevent the accumulation of solvent fumes which will retard the curing of the paint or create an explosion and fire hazard.

J. In addition, during paint spraying operations on tank interior, applicator shall be provided with fresh air by means of fresh air mask.

K. Sufficient lighting shall be provided to insure proper safety conditions and permit inspection. Spotlights attached to blast nozzles are recommended to provide sufficient illumination on the surface being blasted. All manholes and other tank openings shall remain open during cleaning, painting, and curing operations.

L. A minimum of 24 hours drying time shall be allowed between coats. For final curing of the interior and exterior paint system, a minimum of seven (7) days is required. These requirements may be modified by the Engineer to accommodate climatic conditions existing at the time the painting is being done, shorter in hot weather, longer in colder weather. Tank shall not be filled until all evidence of solvent odor is gone.

M. Hand scrape and solvent wipe interior surfaces to remove grease coating. Prior to painting, all surfaces shall be cleaned free of all rust, dust, dirt, mill scale, existing paint, and any other foreign interference materials. The removal of these items shall be accomplished by completely sandblasting all surfaces in accordance with Steel Structures Painting Council SSPC-SP-10 (near white) sandblast. All surfaces cleaned shall be prime painted the same day the cleaning operation is performed. Approved blasting abrasive shall be Monokleen Mineral Grit, 10-40 mesh, or approved equal free of silica or sand.

N. The interior coating system shall be of the high-build epoxy type. The system shall be supplied by Pennsbury Coatings or approved equal as follows:

1. Primer Coat: Pennsbury PENN-CHEM coating 54-W-23 White PONAMID H-B Solution Tank Liner, applied to a dry film thickness (D.F.T.) 4.0 mils. (6.0 - 7.0-mils wet).

2. Finish Coat: Pennsbury PENN-CHEM coating 54-D-452 Sand PONAMID H-B Solution Tank Liner, applied to a D.F.T. of 5.0 to 6.0 mils (10.0 mils wet).

O. Prior to painting, all exterior surfaces shall be cleaned free of all rust, dust, dirt, mill scale, existing paint, and any other foreign interference materials. The removal of these items shall be accomplished by sandblasting all surfaces in accordance with Steel Structures Painting Council SSPC-SP-6 (commercial sandblast. All surfaces cleaned shall be prime painted the same day the cleaning operation is performed. Approved blasting abrasive shall be Monokleen Mineral Grit #10-40 mesh, or approved equal free of silica or sand.

P. The exterior coating system shall be of the urethane type as supplied by Pennsbury Coatings or approved equal as follows:

1. Primer Coat: Pennsbury 51-P-1 PONAMID Primer applied to a D.F.T. of 2.0 to 3.0 mils, (4.0 to 6.0 mils wet).

2. Second Coat: Pennsbury 54 Series PONAMID H-B applied to a D.F.T. of 2.5 to 4.0 mils dry, (3.0 to 4.0 mils wet).

3. Third Coat: Pennsbury 40 Series PENNOPOL URETHANE applied to a D.F.T. of 1.5 to 2.0 mils, (3.0 to 4.0 mils wet).

4. The intermediate (second) coat shall be shaded close to the finish color. The total dry film thickness of the three-coat system shall range between 6.0 to 9.0 mils.

5. Materials to be applied by brush or roller.

Q. Paint Thickness

The dry film thickness and uniformity of the paint coatings shall be measured using an Elcometer or Microtest gauge supplied by the Contractor and available for use at the job site. The Owner reserves the right to use a low voltage holiday detector to check the finished paint integrity and to utilize a representative of the paint manufacturer for testing.

The paint manufacturer shall perform a final inspection with the Contractor and Owner present. Any deficiencies in the finish painting system shall be corrected by the Contractor at no cost to the Owner or the paint manufacturer. Upon completion of the inspection, the paint manufacturer shall provide the Owner a final inspection letter indicating inspection results.

1.05 DISINFECTION OF TANK

A. The sterilization procedure shall conform to the spray sterilization procedure as described in the latest revision to AWWA C652-86. A minimum of seven (7) days following the application of the final coat on the interior surfaces shall be allowed before sterilization.

B. This solution can be obtained by adding one (1) ounce of calcium hypochlorite (HTH) to each twenty-six (26) gallons of water. After two (2) hours, the surfaces shall be thoroughly rinsed with clean potable water to waste. All interior surfaces of the tank which will ultimately be in contact with stored water shall be thoroughly sprayed to run off with water containing 200 parts per million of chlorine.

C. Personnel working inside the tank during sterilization shall be equipped with suitable air masks and safety lines leading through a manhole to personnel outside the tank. All safety precautions shall be observed as required by OSHA.

1.06 GUARANTEE

A. The tank contractor shall guarantee the structure against any defect in materials or workmanship including paint and painting for a period of one (1) year from the day of acceptance. The tank shall be drained, cleaned and inspected in the presence of the Township prior to the expiration of the warranty. In case any such defect shall appear and is reported in writing to the Contractor during the guarantee period, the Contractor shall make necessary repairs without charge to the Owner.

END OF SECTION

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SECTION 15400

WATER SUPPLY PIPING AND VALVING

PART 1 GENERAL

1.01 WORK INCLUDED

A. Section includes piping, fittings, anchors, buttresses, valves, and related appurtenances for potable water supply lines.

1.02 REFERENCE STANDARDS

A. Conform to the following reference standards where applicable:

1. Ductile Iron Pipe: ANSI A21.51

2. Gate Valves: AWWA C509 - Resilient Wedge Valves

1.03 QUALITY ASSURANCE

A. Materials and installation shall conform to manufacturer's specifications and instructions.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Where manufacturers' products are specified, it is for the purpose of establishing a standard of quality and construction.

B. Equivalent products of other manufacturers may be substituted with Engineers approval.

2.02 DUCTILE CAST IRON PIPE (DCIP)

A. Ductile cast iron pipe shall conform to ANSI A21.51 and shall have an ANSI Class 52 thickness minimum unless otherwise specified. Pipe thickness will increase with larger service taps – for example service taps greater than one-inch in 8-inch DIP will require class 56. All pipe must be AWWA approved (C-100).

B. Ductile iron pipe and fittings shall have minimum 1/8 inch cement lining with bituminous seal coating in accordance with the ANSI A21.4, latest edition. All pipes shall have bituminous outside coating in conformance with ANSI A21.51, latest edition.

C. Above ground or exposed ductile cast iron pipe shall be flanged in accordance with ANSI A21.10. Buried ductile cast iron pipe shall have flanges (ANSI A21.10); push on joints (Clow Super Bell-Tite or approved equal; or mechanical joints).

D. Ductile iron pipe and fittings shall have mechanical restrained joints or push-on joints, and shall be for 350 psi working pressure with a thickness Class 52 in accordance with ANSI A21.50, latest edition.

E. The pipe will be laid on 6” stone bedding with select backfill as per Section 02225 of these specifications. The backfill will be compacted and 4’ of cover will be maintained over the top of the pipe except as stated otherwise on the plans.

2.03 WALL SLEEVES

A. All pipes passing through walls or other structural members shall utilize sleeves or wall pipes.

B. Wall sleeves shall be caulked type cast iron or steel wall sleeves with intermediate water-stop flange as manufactured by James B. Clow& Sons, Inc. F-1430 or F-1413 or approved equal.

C. Intermediate wall collars as manufactured by James B. Clow& Sons, Inc., F-1428 (flanged both ends), F-1426 (flanged and plain end) or approved equal.

D. Space between pipe and sleeves shall be caulked or filled with non-shrink grout.

2.04 FITTINGS

A. Fittings shall in general be of the same material, weight, and class and shall have the same lining and coating as the pipelines in which they are installed.

B. Unless otherwise shown on the Contract Drawings, cast iron flanged fittings and blind flanges shall meet ASA B16.1 standards for Class 125 fittings. AWWA C110 fittings, where shown on the Drawings, shall be Class D. Base fittings shall be provided where shown or required. Where indicated, fittings or specials shall be provided with AWWA Standard lugs.

C. Restrained mechanical joints shall be used at all tees, bends, reducers, and valves. Push-on joints are suitable for all other joints. Mechanical joints shall be Snap-Lock; Push-on joints shall be “Super Bell-Tite” in accordance with ANSI A21.10, latest edition. Joints shall have natural rubber or SBR gaskets as manufactured by Griffin Pipe Products Company or equal.

D. Where flexible pipe couplings are necessary, they shall be Dresser Style 53 with coupling bolts of corrosion resistant special alloy “Dresserloy” as manufactured by Dresser Manufacturing Division, Bradford, PA.

E. Ductile iron pipe compact fittings, in accordance with ANSI 21.53, latest edition, may be furnished in lieu of standard joint fittings.

2.05 COPPER PIPE

A. Material:

1. 1-1/2" and smaller: Type "L" hard.

2. 2" and Larger: Type "K" hard.

3. Underground: Type "K" soft.

B. Standards: ASTM B-88

C. Fittings: Wrought copper, ANSI B16.22; dielectric fittings between copper and steel pipe as manufactured by EPCO or equal.

D. Joint material: Silver-solder shall be used on all copper piping.

2.06 STEEL PIPE

A. Standards: ANSI B125.2. ASTM A-120

B. Weight: Schedule 40 min.

C. Finish: Black or galvanized as indicated.

D. Fittings:

1. Screwed: Malleable iron, ANSI B16.3, 150 lb. black or galvanized as specified; cast iron, ANSI B16.12, galvanized drainage fittings, ANSI 16.4 pressure rated fittings.

E. Unions:

1. 2-1/2" and smaller: Screwed pattern, malleable iron, 125 lb., galvanized or black finish matching pipe.

2. 3" AND LARGER: Flanged pattern, ANSI B16.1, 125 lb., cast iron.

2.07 POLYETHYLENE PIPE

A. General

1. All potable water polyethylene pipe supplied under this Specification shall be High Density Polyethylene Pipe (HDPE) PE 3608 (SDR 9) conforming to the latest edition of ANSI/AWWA C901 and ANSI/NSF Standards 14 and 61. Resin used in the extrusion of water polyethylene pipe shall conform to the latest addition of the ASTM D 3350 Cell classification 335434C with the specifications stated herein.

2.08 PRESSURE RELIEF VALVE

A. The pressure relief valve shall maintain constant upstream pressure by by-passing or relieving excess pressure, and shall maintain close pressure limits without causing surges. The main valve shall be a hydraulically operated, diaphragm-actuated, globe or angle pattern valve. It shall contain a resilient, synthetic rubber disc, having 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. The diaphragm assembly containing a valve stem shall be fully guided at both ends by a bearing in the valve cover and an integral bearing in the valve seat. This 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. The diaphragm shall consist of nylon

fabric bonded with synthetic rubber and shall not be used as a seating surface. Packing glands and/or stuffing boxes are not permitted and there shall be no pistons operating the valve or pilot controls. All necessary repairs shall be possible without removing valve from the line. The pilot control shall be a direct-acting, adjustable, spring-loaded, diaphragm valve, designed to permit flow when controlling pressure exceeds spring setting. The pilot control system shall operate such that an excess line pressure is dissipated, the main valve shall gradually close to a positive, drip-tight seating. This valve shall be manufactured by Cla-Val Co., Newport Beach, California, or approved equal.

2.09 GATE VALVES

A. Valves shall be located so that the operators are positioned to be readily accessible for operation. The valves shall be inspected prior to installation, and shall be so installed that they will carry no stresses induced by loads transmitted by adjacent piping. Valves shall be lubricated and ready for service prior to installation.

B. All ductile Iron Gate valves 3" through 16" shall be resilient seated gate valves, and shall consist of a gate with a bonded elastomer seat, which in the closed position is fully encapsulated and effects a seal upon a cast iron body resulting in a bubble-type seal across this disk at a full differential of 250 psi. The valve shall be equipped with a corrosion-resistant threaded bronze stem, acting through a bronze stem nut fixed into the disk in such a way as to force the disk seat into the body, effecting a seal when the stem is torqued in the desired direction. All internal parts shall be accessible without removing the main body from the pressure line. All ductile iron internal parts shall be coated completely with a bonded epoxy corrosion resistant coating. All outside surfaces of ferrous parts shall be protected with the same fusion bonded epoxy coating and meet ANSA/AWWA C550 standards. The resilient-seated gate valve shall meet or exceed AWWA C509 standards. The valves shall be U.S. Pipe Metro Seal 250*. All gate valves, except those for underground service, shall be of the rising stem type (OS & Y with handwheel). Buries valves shall have non-rising stems and shall be furnished with a 2 inch operating nut and valve boxes with covers. All valves shall open left. Gate valves 3 inches and smaller shall be bronze-bodied, bronze-mounted, wedge disk outside screw-in yoke construction for 200 pounds static water pressure.

* 5460 for buried service / 5120 for interior service.

C. Valve Boxes

1. Valve boxes shall be two-piece screw type cast iron with flared round base. Boxes to be equipped with cover and the word "WATER" cast into the cover. Boxes to be used on each buried valve. Boxes shall be of sufficient length that when installed to the depth of the cover required, they shall be capable of an additional three (3") to full extension.

2. Valve boxes shall be two-piece with 5-¼" diameter shaft, Model H-10360, as manufactured by Mueller Company.

2.10 BUTTERFLY VALVES

A. Butterfly Valves

1. Contractor shall furnish and install on water lines 16” to 20” in diameter, butterfly valves meeting the requirements of AWWA Standard Specification C504 in locations as shown on the plans. Valves shall be of the tight-closing, rubber-seat type with rubber seats that are securely fastened to the valve body. No metal-to-metal seating shall be permitted. Valves shall be bubble-tight at the rated pressures with the flow in either direction.

2. Valve disks shall rotate 90 degrees from the full open position to the tight shut position.

3. Valve bodies shall be constructed of cast iron.

4. Valve disks shall be constructed of cast iron with Ni-Chrome edge.

5. Valve shafts shall be constructed of 18-8 Type 304 or Type 316 stainless steel.

6. Valve seats shall be of a synthetic compound simultaneously molded in, vulcanized, and bonded to the body.

7. Valves shall be fitted with sleeve-type bearings. Bearings shall be corrosion resistant and self-lubricating.

8. Manual operators shall be of the traveling nut, self-locking type and shall be designed to hold the valve in any intermediate position between fully open and fully closed without creeping or fluttering. Operators shall be equipped with mechanical stop-limiting devices to prevent over-travel of the disc in the open and closed positions. Valves shall close with a clockwise rotation. Operators shall be fully enclosed.

9. The manufacturer shall have manufactured tight-closing, rubber-seat butterfly valves for a period of at least five years. All valves shall be Groundhog Butterfly Valves as manufactured by the Henry Pratt Company or approved equal.

10. Equip operator with the Pratt Diviner Ground Level Position Indicator. Use a 1-1/4” square extension stem with a 2” square wrench nut to locate operating nut and position indicator 6” to 12” below grade.

2.11 CHECK VALVES AND BACKFLOW PREVENTORS

A. Swing Check Valves

1. Swing Check Valves shall be constructed with heavy cast iron body with a bronze or stainless steel seat ring, a noncorrosive shaft or attachment of weight and lever, complete noncorrosive shockless chamber.

2. They shall absolutely prevent the return of water back through the valve when the inlet pressure decreases below the delivery pressure. Valves must be tight seating, and must be shockless in operation. The seat ring must be renewable.

3. The cushion chamber shall be attached to the side of the valve body externally and so constructed with a piston operating in a chamber that will effectively permit the valve to be operated without any hammering action. The shock absorption by air, and the cushion chamber shall be so arranged that the closing speed will be adjustable to meet the service requirements.

4. The valve disc shall be of cast iron and shall be suspended from a noncorrosive shaft which will pass through a stuffing box and be connected to the cushion chamber on the outside of the valve.

5. All material and workmanship shall be first-class throughout and the purchaser reserves the right to inspect this valve before shipment.

6. The valve shall be manufactured by the GA Industries, Inc. Mars, PA or approved equal conforming to AWWA C508.

B. Water Service Backflow Preventer

1. A water service backflow preventer assembly shall be installed on all residential and non-residential water supply lines and fire services as they enter the building and on all residential connections as required by the IBC Plumbing Code. All backflow preventers' shall meet the IBC Code and AWWA specifications for the use intended whichever code is more stringent.

2.12 PIPE SUPPORT

A. Pipe Support

1. Piping shall be firmly and properly supported by malleable or wrought iron hangers, guides, saddles, clamps, etc., as necessary. Concrete pedestals or piers shall be provided where indicated or required. Where drilling of anchor bolt holes becomes necessary, the Contractor shall secure permission from the Engineer prior to stating the drilling. The Contractor shall furnish and install all necessary supports, hangers, guides, saddles, clamps, etc. required to provide a complete operational facility. The type of hangers, guides, etc. shall be reviewed with the Engineer and meet with his approval.

2.13 FIRE HYDRANTS

A. General

1. Hydrants shall be of the compression type; the main valve closes with water pressure and will stay closed if the hydrant is accidentally broken or the bonnet removed for inspection. Hydrants shall comply with AWWA Specification C502, latest edition

B. Hydrants

1. All hydrants shall be model Centurian as manufactured by Mueller Company. Approval drawings are required.

2. Fire Hydrants shall:

   a. Have a cast iron body

   b. Be fully bronze mounted

   c. Be equipped with non-kinking nozzle cap chains

   d. Have safety flange

   e. Have two piece safety stem coupling

   f. Have a positive stop

   g. Be suitable for a working pressure of 150 psi

   h. Have two 2-1/2" (NS) hose connections and one 4-1/2" steamer connection complete with cap gaskets and operating nut (1-1/2" pentagon)

   i. Have 6" mechanical joint end connection

   j. Have an arrow cast on the hydrant head to indicate counter-clockwise direction of opening

   k. Have a valve size opening of 5-1/4"

   l. Be equipped with a gate valve and valve box ahead of (but not integral with) the hydrant

   m. Be painted with one coat of yellow lead primer and two coats of yellow enamel.

C. Setting Fire Hydrants

1. Hydrants shall be located as shown or as directed by the Engineer so as to provide complete accessibility and minimize the possibility of damage from vehicles or injury to pedestrians.

2. All hydrants shall stand plumb and shall be set to the established grade with nozzles at least 18" above finished grade, as shown or as directed by the Engineer.

3. Drainage shall be provided to the base of the hydrant by placing coarse gravel or crushed stone mixed with sand from the bottom of the trench to at least 6" above the barrel drain openings and to a distance of 1' around the elbow.

4. The bowl of each hydrant shall be well braced against unexcavated earth at the end of the trench with a concrete reaction backing.

5. Unless a hydrant tee has been installed, hydrant valves shall be restrained by stainless steel bolts, rods, or mechanical joint restraining gland such as EBAA Iron, Inc., MEG A LUG, or equal. If this will place the valve box within a sidewalk area, the concrete around the valve box shall be separated from the sidewalk concrete by ½" minimum premolded expansion joint material. Size of boxed out area to be 18" square.

6. Pipe from water main to hydrants shall be horizontal. If vertical adjustment to bring hydrant to grade is greater than 6 feet, two 45 degree bends, properly buttressed, shall be installed to accomplish the aforementioned requirement; however, if bury is 6 feet or less, pipe shall be installed horizontal by proving a deeper bury hydrant.

2.14 BLOWOFFS/FLUSHING HYDRANTS

A. If a fire hydrant is not required, a flushing hydrant or cap and blow off shall be installed at all dead ends. Blow off shall be an Eclipse #85 or approved equal. Refer to Standard Detail Drawings for blow off and the following for flushing hydrants. Flushing hydrants shall:

1. Meet AWWA Specification C502, latest edition

2. Be of the compression type

3. Be fully bronze mounted

4. Be equipped with non-kinking nozzle chains

5. Have a positive stop

6. Be suitable for a working pressure of 150 psi

7. Have one 2-1/2" (NS) hose connection with cap gasket and operating nut (1-1/2" pentagon)

8. Have arrow cast on hydrant head to indicate counter-clockwise direction of opening

9. Have a valve size opening of 2-1/8"

10. Have a 3" mechanical joint shoe

11. Be equipped with a gate valve and valve box ahead of (but not integral with) the hydrant

12. Be painted with one coat of yellow lead primer and two coats of yellow enamel.

2.15 TAPPING SLEEVES AND TAPPING VALVES

A. Tapping valves shall be mounted vertically and shall be of the same construction as described for gate valves, with the exception:

1. Inlet ends of the tapping valve shall have an inlet flange Class 125 and conform to the configuration of the Mueller Company #667

2. Tapping sleeves shall have an outlet flange Class 125. They shall be of the mechanical joint type as manufactured by Mueller Company #H-615 or approved equal.

PART 3 EXECUTION

3.01 GENERAL

A. Contractor shall furnish and install water main pipe and fittings at the locations shown on the plans and as directed by the Engineer. Approval drawings for all items specified in this section are required.

B. Applicable sections of these specifications on trench excavation, pipe installation; trench backfill, hydrostatic testing, and disinfecting shall apply to water main construction.

C. Service lines in or under Pennsylvania Department of Transportation roads or right-of-ways are to be installed by a method approved by both PennDOT and the Engineer. Water Mains installed in Township roads are to be installed by a method approved by the Engineer to the specification of the Township.

3.02 PIPE HANDLING AND STORAGE

A. All pipe, fittings, valves, hydrants, and accessories shall be loaded and unloaded by lifting with hoists or skidding in order to avoid shock or damage. Under no circumstances shall such material be dropped. Pipe handled on skidways shall not be rolled or skidded against pipe on the ground.

B. Padding – Slings, hoods, or pipe tongs shall be padded and used in such a manner as to prevent damage to the exterior surface or internal lining of the pipe.

C. Storage – Materials, if stored shall be kept safe from damage. The interior of all pipe, fittings, and other appurtenances shall be kept free from dirt or foreign matter at all times. Ends shall be capped. Valves and hydrants shall be drained and stored in a manner that will protect them from damage by freezing.

D. Pipe shall not be stacked higher than the limits shown in the table below. The bottom tier shall be kept off the ground on timbers, rails, or concrete. Pipe in tiers shall be alternated: bell, plain end; bell plain end. At least two rows of timbers shall be placed between tiers, and chocks shall be affixed to each timber in order to prevent movement. The timbers shall be large enough to prevent contact between the pipe in adjacent tiers.

E. Gaskets for mechanical and push-on joints shall be stored in a cool location, out of direct sunlight. Gaskets shall not come in contact with petroleum products. Gaskets shall be used on a first-in, first-out basis.

F. Mechanical-joint bolts shall be handled and stored in a dry location in a manner that will ensure proper use with respect to types and sizes.

G. Prolonged exposure to sunlight will eventually deteriorate polyethylene film. Therefore, such exposure prior to backfilling the wrapped pipe should be kept to a minimum. If several weeks of exposure prior to backfilling are anticipated, Class C material should be used (See ANSI/AWWA C105/A21.5).

Nominal Pipe Size (in)	Number of Tiers
3	18
4	16
6	13
8	11
10	10
12	9
14	8
16	7
18	6
20	6
24	5
30	4
36	4
42	3
48	3
54	3

H. During construction, all ends of pipes or conduits, and all equipment connections shall be left closed with caps, plugs, or wooden flange covers, so as to prevent entrance of dirt, building materials, or other foreign matter.

3.03 TESTING

See Section 01400 Part 2.02.

3.04 BUTTRESSES AT FITTINGS

A. Buttresses at Fittings

1. Buttresses shall be used in all pressure lines at all valves, bends, tees, and at reducers or other fittings where changes in direction or pipe size occur. The buttresses shall be as shown on the Drawings.

2. Thrust blocks shall be constructed at the locations and the size shown on approved Plans, Standard Details, or as directed and required by the Engineer. Thrust blocks shall be constructed so their bearing surfaces are in direct line with major forces created by the pipe or fitting.

3.05 DISINFECTION

A. General

1. All piping, fittings, and related equipment shall be disinfected, as herein specified before water is used for domestic consumption. The procedure to be used shall be in accordance with the latest edition of AWWA C651 tablet method or as otherwise approved by Engineer.

2. Water for Disinfection

a. Water for disinfection shall be furnished by the Contractor from an approved source; the Contractor shall furnish and install all bulkheads, pipes, valves, taps, plugs, labor and other equipment required to sterilize the facilities.

B. Cleaning and Swabbing

1. Precautions shall be taken to protect the interiors of pipes, fittings, and valves against contamination. Pipe delivered for construction shall be strung so as to minimize entrance of foreign material. All openings in the pipeline shall be closed with watertight plugs when pipe laying is stopped at the close of the day's work or for other reasons, such as rest breaks or meal periods. Rodent-proof plugs may be used where it is determined that watertight plugs are not practicable and where thorough cleaning will be performed by flushing or other means.

2. If dirt enters the pipe, and in the opinion of the owner's engineer or job superintendent the dirt will not be removed by the flushing operation, the interior of the pipe shall be cleaned by mechanical means and then shall be swabbed with a 1-percent hypochlorite disinfection solution. Cleaning with the use of a pig, swab, or "go-devil" should be undertaken only when the owner's engineer or job superintendent has determined that such operation will not force mud or debris into pipe-joint spaces.

C. Wet-Trench Construction

1. If it is not possible to keep the pipe and fittings dry during installation, every effort shall be made to assure that any of the water that may enter the pipe-joint spaces contains an available-chlorine concentration of approximately 25 mg/L. This may be accomplished by adding calcium hypochlorite granules or tablets to each length of pipe before it is lowered into a wet trench, or by treating the trench water with hypochlorite tablets.

D. Flooding by Storm or Accident During Construction

1. If the main is flooded during construction, it shall be cleared of the floodwater by draining and flushing with potable water until the main is clean. The section exposed to the floodwater shall then be filled with a chlorinated potable water that, at the end of a 24-h holding period, will have a free chlorine residual of not less than 25 mg/L. The chlorinated water may then be drained or flushed from the main. After construction is completed, the main shall be disinfected using the continuous-feed or slug method.

D. Tablet Method

1. The tablet method consists of placing calcium hypochlorite granules and tablets in the water main as it is being installed and filling the main with potable water when installation is completed.

2. This method may be used only if the pipes and appurtenances are kept clean and dry during construction.

3. Placing of calcium hypochlorite tablets - During construction 5g calcium hypochlorite tablets shall be placed in each section of pipe and also one such tablet shall be placed in each hydrant, hydrant branch, and other appurtenance. The number of 5g tablets required for each pipe section shall be .0024d2 L rounded to the next higher integer, where d is the inside pipe diameter, in inches, and L is the length of the pipe section, in feet. Table 15400-2 shows the number of tablets required for commonly used sizes of pipe. The tablets shall be attached by an adhesive such as permatex No. 1 or equal. There shall be no adhesive on the tablet except on the broad side attached to the surface of the pipe. Attach all the tablets inside and at the top of the main, with approximately equal numbers of tablets at each end of a given pipe length. If the tablets are attached before the pipe section is placed in the trench, their position shall be marked on the section so it can be readily determined that the pipe is installed with the tablets at the top.

4. Filling and Contact - When installation has been completed, the main shall be filled with water at a rate such that water within the main will flow at a velocity no greater than 1 ft/s. Precautions shall be taken to assure that air pockets are eliminated. This water shall remain in the pipe for at least 24 hours. Valves shall be positioned by the owner so that the strong chlorine solution in the treated main will not flow into water mains in active service.

Number of 5-g Calcium Hypochlorite Tablets

Pipe Diameter (in.)	Length of Pipe Section (Ft)				
	13 or less	18	20	30	40
4	1	1	1	1	1
6	1	2	2	3	3
8	2	3	3	5	6
10	3	4	5	7	10
12	4	6	7	10	14
16	8	11	12	18	18

3.06 SERVICE CONNECTION

A. General

1. Contractor shall furnish and install service connection fittings and pipe at the locations shown on the plans and as directed by the Engineer. Approval drawings for all items specified in this section are required. Mueller 110 compression connections are to be used.

2. Applicable sections of these specifications on trench excavation, pipe installation; trench backfill, hydrostatic testing, and disinfecting shall apply to service connections.

3. Service lines in or under Pennsylvania Department of Transportation roads or right-of-ways are to be installed by a method approved by both PennDOT and the Engineer. Service lines installed in Township roads are to be installed by a method approved by the Engineer to the specification of the Township.

B. Corporation Stops

1. Corporation stops shall be Mueller Company No. B-25008 or approved equal, installed as shown in the standard details. Saddles shall be used with plastic pipe.

C. Curb Stops

1. Curb stop shall be Mueller B25209 one-inch (1”) stops. Curb boxes shall be installed with each corporation stop in accordance with the standard details. For plastic pipe, Mueller Company No. H15159 curb stop shall be used with liners.

D. Curb Boxes

1. Curb boxes shall be cast iron of sufficient length to reach the surface of the ground, but shall not extend above the surface. The boxes shall have the word "WATER" cast in the lid. Curb boxes shall be Mueller No. H10314 with 89982 lids and stationary rods or approved equal.

E. Meter Stops

1. Meter stop shall be sized in accordance with the service line and have a copper inlet with swivel nut with Mueller 110 conductive compression couplings. Mueller type H-14253 for key angle meter stops and H-14348 for straightway meter stops.

F. Pressure Reducing Valves

1. Pressure Reducing Valves shall be factory pre-set to 50 PSI, conform to all AWWA specifications for bronze bodied units, be properly sized and installed according to thedictates of the connection as shown of the plans.

G. Water Meters

1. Water meters shall be sized for the service duty as approved by Engineer.Meter shall have a local read-out and a remote radio read, as manufactured by Neptune model T-10 meter with an electronic IMIU.

H. Service Pipe

1. All service connections between the water main and the curb stop shall be 1" or greater copper tubing. All copper tubing shall meet the requirements of ASTM Specifications for Seamless Copper Water Tube, B-88, Type K.

    a. All tubing laid in the ground shall be Type K annealed, furnished in coils. All fittings shall be compression fittings.

    b. Annealed, Type K, copper tubing shall be cut square using suitable tools. Bending tools shall be used in making bends.

2. All new water service pipes from the curb box to the meter shall not be less than one inch, type K copper or HDPE Copper Pipe Size DR 9, unless otherwise provided in this section. Replacement of existing water service pipes from the main to the curb stop shall be one-inch type K copper or HDPE Copper Pipe Size DR9. All fittings and connections shall be uniform and comply with specifications established by Buckingham Township. Stainless steel stiffeners must be used on all HDPE connections. If HDPE is used for the service, a tracer wire must be installed adjacent to the service pipe, and it must terminate in a tracer wire termination box. The tracer wire termination box must be placed within one foot of the curb box and must be tested. All tracer wires must be grounded using a brass anchor to attach a one-half inch by three foot brass grounding rod to the stripped wire. All service pipes shall be buried a minimum of 3 1/2 feet

deep in the ground. No installation shall be covered until inspected and approved by Buckingham Township. HDPE pipe must meet the AWWA C901 Standard andand ANSI/NSF Standards 14 and 61.

4. Service lines shall be installed in accordance with the most recent IBC plumbing code adopted by Buckingham Township. Service lines less than 100' shall be continuous without joints, installed in a straight trench. Curb stop boxes shall not be installed in paved areas.

3.07 MISCELLANEOUS

A. Where necessary to join pipe of differing types, Contractor shall furnish and install necessary adapters. Adapters shall have ends conforming to the above specifications for the appropriate type of joint to receive the adjoining pipe.

B. Any pipe of fittings showing a dent or crack, pipe stored improperly, including not properly racked and capped, and any fitting or pipe which has received a severe blow that may have caused an incipient fracture, even though no such fracture is visible, shall be marked as rejected by the owner or Engineer and removed at once from the work area.

C. Every care shall be taken in handling and laying pipe and fittings to avoid damaging the pipe, scratching or marring machined surface, and abrasion of the pipe coating.

D. Except as otherwise approved, all cutting of ductile iron pipe shall be done with an approved power-drive cutter. Bevel the cut end of the pipe with a heavy file or grinder to remove all sharp edges, prior to inserting cut pipe into the bell.

END OF SECTION

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SECTION 15401

WATER SUPPLY WELLS

PART 1. GENERAL

1.01 Section includes drilling, fitting and testing of potable water supply wells.

1.02 The Buckingham Township Well Ordinance shall apply to the permitting of water quality and quantity testing and is included herein by reference. It shall also apply to the construction of individual residential wells. In cases where there are conflicts between this specification and the Well Ordinance., the Ordinance shall prevail.

1.03 The Pennsylvania Department of Environmental Protection and Delaware River Basin Commission current criteria shall apply.

1.04 The Township reserves the right to reject any wells not meeting the current level of water quality in the Township's system without pretreatment.

1.05 A pre-drilling conference shall be held with the Township to review the well location, monitoring and testing procedures and design requirements.

1.06 These specifications are intended to cover "public water systems" as defined in the Buckingham Township Water Service Rules, Regulations and Specifications. They do not apply to individual residential wells, with the exception of Well Abandonment Section 8.02.

PART 2. PERMITS

2.01 The developer shall apply for and acquire permits from all authorized agencies including the Township of Buckingham. No field operations shall commence until these necessary approvals have been obtained. The Township's Engineer shall be notified prior to the drilling of any wells or the start of any testing.

PART 3. MATERIALS

3.1 Well Casing:

The well casing and liners forming the permanent well shall be constructed of new, durable, and non-toxic material sufficient to protect the well against structural deficiencies during the construction and against entrance of pollutants during the expected life of the well. All casing and liner pipe shall be Schedule 40 steel pipe and all joints shall be watertight.3.02 Grout:

Cement Grout - a mixture of Portland cement and not more than six gallons of water per bag (94 lbs.) of cement. The use of bentonite (up to 2% by weight of cement) to reduce shrinkage may be used. The water used shall be fresh, clean and potable. If the water is questionable, it shall be tested in accordance with ASTM C109.

3.03 Pump:

The pump shall be a submersible well pump capable of supplying the design flow at the specified head. The pump shall be manufactured by Goulds. The pump shall have a discharge pipe and a sufficient length of unspliced cable to extend the entire depth of the well. Power shall be supplied to the well from the operation building through unspliced direct burial cable in PVC conduit.

3.04 Pitless Adapter

The pitless adapter shall be DEP approved and be equipped with an overflowing well spool piece. It shall be manufactured by the Baker Company or approved equal.

3.05 Accessories

Well pump shall be fitted with a positive sealing check valve constructed of bronze or stainless steal and supplied by the pump manufacturer.

PART 4 . CONSTRUCTION OF THE WELL

4.01 General

The well shall be drilled at the approximate location shown on the project drawings in compliance with local, state or federal requirements or recommendations. Suitable drilling equipment shall be used to drill the hole and install the materials previously described. Any drilling fluid pits required should be positioned at least 6 feet from the proposed pump foundation pad or the top of the well if a foundation pad is not required.

All drilling fluid, cuttings, and discharged water shall be disposed of in a manner acceptable to the Township and in compliance with local, State and other laws.

4.02 Construction

The well shall be double cased and large enough to enclose the pump in a method, which conforms to the requirements of the Department of Environmental Protection.

PART 5. TESTING THE WELL

5.01 The well shall be tested a minimum of 72 hours to determine if it is capable of yielding the quantity and quality of water necessary to satisfy the requirements of the Buckingham Township Well Ordinance, to have no adverse impact on neighboring wells and meet the requirements of the Department of Environmental Protection, Buckingham Township guidelines and the Delaware River Basin Commission (DRBC). All tests shall be done under the Engineer's review.

5.02 Plumbness and Alignment:

The well, before being officially accepted, shall be tested by the well driller for plumbness and alignment. A 40-foot section of pipe, or rigid dummy of the same length, having an outside diameter not more than 1/2" smaller than the diameter of the casing or hole being tested, should move freely throughout the length of casing or hole to the lowest

anticipated pump setting. The well should not vary from the vertical in excess of two-thirds of the smallest inside diameter per 100-foot of depth, of that part of the well being tested. The well driller shall provide certification as to the plumbness and alignment of the well.

5.03 Complete bacteriological and chemical analysis meeting the requirements of the "Buckingham Township Well Ordinance", EPA and DEP requirements for public water supply must be conducted by a DEP approved lab.

PART 6. INSTALLATION OF PUMP AND CAPPING THE WELL

The Contractor is responsible for installing the permanent pump and installing a pitless adapter. The pitless adapter shall be a Monitor PS as manufactured by Baker Manufacturing Company, Evansville, Wisconsin or an approved equal and meet the Department of Environmental Protection requirements.

PART 7. DISINFECTION

7.01 The well shall be disinfected after the permanent pump has been installed but before putting it into service.

7.02 The well shall be disinfected by introducing a chlorine solution into the well in such a manner that a concentration of at least 50 ppm of available chlorine exists in all parts of the well at static conditions. The chlorine solution shall be introduced into the well in such a manner that the well surface above the static level will be completely flushed with the solution. A minimum of 24 hours contact time shall be provided before pumping the well to waste. The Contractor is responsible for assuring no environmental damage is caused by discharging the chlorinated water.

PART 8. ABANDONED HOLE

If the well fails to conform to these specifications and the Contractor is unable to correct the condition at his own expense, it shall be considered an abandoned hole and the Contractor shall immediately start a new well at a nearby location approved by the Township.

8.01 Unless the Township requires the abandoned well as a monitoring well, the Contractor may salvage as much casing and screen as possible from the abandoned hole. The salvaged materials shall remain the property of the Contractor.

8.02 If the abandoned well is not required as a monitoring well, the well shall be filled and sealed according to the procedures established by the Commonwealth, the Buckingham Township Well Ordinance and Section 15404 of these specifications.

PART 9. RECORDS

9.01 The Contractor will provide the Township with a copy of the well log containing the following information:

A. Drill cuttings and records shall be obtained at five-foot intervals, and at all pronounced changes in formation should be supplied to the Owner.

B. A complete casing location record showing lengths of each diameter of casing.

C. All test data, including static water level, length of test, rate of discharge and all drawdown measurements on all monitoring wells.

D. Upon request, the Contractor will supply the Engineer with water samples suitable for chemical and/or microbiological analysis.

END OF SECTION

SECTION 15403

INDIVIDUAL COMMUNITY WATER SYSTEMS

PART 1. GENERAL

1.01 Definitions

A. Individual Community Systems - These shall be water systems developed under the Public Water System Ordinance serving individual residential or commercial developments but not physically connected to Buckingham Township's existing systems.

B. Ordinance - The term "Ordinance" shall refer to Buckingham Township Pubic Water System Ordinance No. 93-02 as adopted by Buckingham Township on February 24, 1993.

1.02 All Individual Community Water Systems whether or not to be owned and/or operated by Buckingham Township shall be individually designed and equipped to meet the Township's specifications. Special site or system conditions precluding the use of the specified system or equipment shall be brought to the Township's attention as soon as possible.

1.03 All requirements of the Pennsylvania Department of Environmental Protection, the Bucks County Department of Health, the Delaware River Basin Commission and the U.S. Environmental Protection Agency shall be met except where they are exceeded by the Township's standards.

PART 2. REQUIREMENT FOR PUBLIC WATER SYSTEM

2.01 Public Water Supply Systems are required for all residential and commercial developments involving 25 or more residential units or the equivalent flow (8750) gallons per day) from commercial development. Where a development's net density is less than one unit per acre, public water systems are not required unless determined by the Board of Supervisors to be needed for public health or safety reasons.

2.02 Connection to the existing water supply system of Buckingham Township may be required where feasible. Feasibility may be established through a detailed 20-year cost evaluation comparing a proposed individual community public water supply system and the connection to the Township's system. Buckingham Township shall make the final determination of the feasibility of connecting to its system.

PART 3. SIZING

All individual community water systems shall be sized based on the following factors:

3.01 Design Flow Rate - The design flow rate for the public water distribution system shall include the fire flow rate plus the maximum anticipated flow rate for all other purposes. Peaking factors will vary depending on the size of the development or number of EDU's proposed. As a general rule, water systems should be designed with a 300-gallon per day baseline EDU with a 1.7 30-day average peak and a daily peak of 2.5. An EDU is equal to a single home with 3 bedrooms housing 4 people.

3.02 Fire Flow Rate - The design fire flow rate shall be determined using the Guide for Determination of Required Fire Flow or applicable ordinances, whichever is greater. As a general rule, the minimum fire flow is 1,000 gallons per minute for a 2-hour duration. Multiple dwelling unit developments will require 1,500 gallons per minute. Commercial fire flows are determined using the highest risk permissible use.

3.03 Sprinkler Flow Rates – If a sprinkler system required by code, the design shall be submitted to Buckingham Code enforcement to determine the correct flow to the unit for sprinklers. Once the flow rate and service size are established for service connection it shall be shown on the development plans.

3.04 Other Flow Rates - All other flow rates shall be as determined by Buckingham Township Water and Sewer Engineer for similar users and approved by the Township.

PART 4. MAJOR SYSTEM COMPONENTS

4.01 Control Building - An all-weather building shall be included in the system to house the following equipment:

A. Chlorination in a separate adequately ventilated room

B. Major Control Valves

C. Meters

D. Electrical Controls

E. Laboratory space including for operators' desks and filing/storage

F. Showers, bathrooms and Employee facilities

G. Other necessary mechanical equipment, including treatment units.

The Control Building shall meet the building specifications of Buckingham Township and be aesthetically compatible with nearby buildings. Telemetry equipment to be supplied compatible with existing Township PLC and SCADA Systems. Raco Verbatim auto dialer to be provided and installed per direction of Township.

4.02 Chlorination Equipment - The chlorination equipment shall be capable of meeting the DEP disinfection requirement and shall utilize sodium hypochlorite. Storage shall be provided for four weeks of 25% sodium hypochlorite and a day tank providing at least 3 days of anticipated storage. The chlorinator shall be manufactured by Liquid Metronics or approved equal. Duplication per Act 109 is required.

4.03 Potable Water Wells - meeting Specification 15401 and the Buckingham Township Well Ordinance. A minimum of 2 wells is required with the peak demand of the system able to be met with the largest well out of service.

4.04 Well Level Monitoring System -

A. Submersible pressure transducers, as manufactured by KPSI or approved Endress-Hauser, fully compatible with the operating and programmable motor control equipment specified. A digital well level recorder is required for the well level.

B. All piping, connectors and appurtenances necessary to operate the system shall be supplied and installed including the transducer line to and down the well.

4.05 Storage – duplicate tanks per Specification Section 15375 and Sections 15380 and 15381 as applicable.

4.06 Telemetry and SCADA – Complete installation with capability to operate system remotely and to communicate to central monitoring station.

4.07 Security – Systems to provide level of security required by Township's security policy and/or that required by the EPA/DEP.

4.08 Distribution piping – Ductile Iron pipe in quantity and size to provide maximum flows at system extremities. Valving on all legs of system T's and crosses. Division 15, Sections 15000 thru 154000 specifically apply. Hydrants and blow-offs as determined by Engineer. Booster pumps as required.

4.09 Miscellaneous Equipment

A. Provision for emergency operation via generator or transfer switch and connection compatible with Township's portable generators as solely determined by Township.

B. Spill containment and floor drain to sanitary sewer.

C. Laboratory equipment – See Section 11601.

D. Eyewash stations - 15 minutes at 0.4 gal/minute; two (2) fire extinguishers; smoke alarm; first aid kit; telephone with all connection to Bell of PA, emergency lighting and emergency shower

PART 5. FLOW METERS

5.01 A flow measure equipment shall be provided for all water sources as specified in Section 15406 – Water Supply Meters.

END OF SECTION

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SECTION 15404

WELL ABANDONMENT

PART 1 GENERAL

1.01 WORK INCLUDED

A. The primary approach for abandoning wells shall be to follow the applicable state Well Abandonment Guidelines established by PA DEP Bureau of Topographic and Geologic Survey.

B. Abandonment of the wells consists of removing the existing pump, piping, and electrical conduit, grouting the hole from the bottom to within 5 feet of the ground surface, cutting off the steel surface casing 1 to 2 feet below ground surface, and restoring the ground surface to its original condition.

C. If well abandonment techniques described herein are inappropriate to site conditions, then the Engineer shall recommend other techniques as approved by PA DEP.

PART 2 PRODUCTS

2.01 EQUIPMENT

A. All equipment shall be in good operating condition and operated and maintained in strict conformance with manufacturer's recommendations.

B. The Contractor shall have the appropriate equipment and trained personnel to perform the work as specified.

C. Provide all tools, grout, water, bentonite, and other necessary equipment and materials for abandoning wells.

D. Grout Seal: The cement used to make the expansive cement-bentonite grout seal shall conform to ASTM C150, Type I or II. The bentonite shall be in powder form and be without additives.

PART 3 EXECUTION

3.01 GENERAL

A. Coordinate the start of well abandonment work with Buckingham Township. It shall also be the responsibility of the Contractor to schedule the abandonment work at the well with the respective well owner.

3.02 ABANDONMENT

A. Begin abandonment by removing the existing pump and associated piping and wiring within the casing. The removed submersible pump shall remain the property of the well owner. All piping, wiring, well caps, and other equipment shall be disposed of by the Contractor as directed by the Owner.

B. Contractor shall note the diameter of the surface casing to determine the water-level depth and sound the well to determine its total depth. This information shall be used to determine the quantity of grout needed to abandon the well and payment for the work. This information shall also be recorded on an abandonment log for the well.

C. Prepare the cement-bentonite grout by proportioning no more than 7 gallons of water per 94-pound bag of Portland cement; 3 to 4 pounds of bentonite per bag of cement shall be used to reduce shrinkage. The grout must be mixed to a smooth consistency using a pump or portable mechanical mixer and shall be free of lumps and other defects, including materials other than cement, bentonite, and water.

D. Contractor shall pump the grout into well through a tremie pipe extended to the bottom of the hole. Continue pumping until the grout is within 5 feet of the top of the hole. Add grout to the hole to maintain its level as the grouting pipe is withdrawn. If loss of grout into subterranean caverns occurs, the hole shall be filled to just below the cavern, bridged above the cavern, and filled from the bridge to within 5 feet of the surface.

E. Contractor shall make a reasonable effort to tremie the grout into well at a rate that does not result in the discharge of groundwater from the well casing to the surface.

F. If the well is in an unpaved area, the Contractor shall restore the area by cutting off the surface casing 1 to 2 feet below ground surface and backfilling the remaining hole with soil and restore the surface to its original condition. If a valve box has been installed, it shall be removed and disposed of by the Contractor.

G. If the well is in a paved or concreted area, the Contractor shall restore the area by cutting off the surface casing 1 to 2 feet below ground surface and backfilling the hole with concrete to near ground surface. Finish the backfilling by topping off the concrete with the surfacing to match existing (i.e. asphalt or concrete). If a valve box has been installed, the chamber cover shall be removed and the box filled with concrete prior to resurfacing.

H. Water piping from the well casing to the house shall be capped at the well casing and left in the ground. Well discharge piping entering the house shall be disconnected from the house distribution system and capped.

I. Electrical feed from the house to the well pump shall be cut at the well casing and left in the ground. Feed wires shall be disconnected at the circuit breaker and capped.

J. Abandonment methods and sealants shall be approved by Buckingham Township prior to use.

3.03 ABANDONMENT RECORDS

A. A water well completion report form shall be completed by the Contractor for each abandoned well and filed within 30 days of abandonment with the PA DEP Bureau *of* Topographic and Geologic Survey, P.O. Box 8453, Harrisburg, PA 17105-8453, phone (717) 787-5828. This report shall be complete and accurate in order to provide detailed records for possible future reference and to demonstrate that the hold was properly sealed. The information included on the report shall consist of, but not be limited to, the following:

1. Well abandonment contractor's company name and personnel.
2. Date of abandonment.
3. Well location map and location by tax parcel number.
4. Well identification number, *if* available.
5. Well use.
6. Abandonment procedures.
7. Depth and diameter of hole.
8. Consistency, quantity, and depth of grout.
9. Static water level and depth.
10. Surface restoration procedure.

END OF SECTION

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SECTION 15405

WATER SERVICE CONNECTIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Water service installation in new developments.

B. Connection of water service to existing water mains.

1.02 REGULATORY REQUIREMENTS

A. Conform to applicable Township, State Department of Environmental Protection and Department of Transportation code for materials and installation of the Work of this Section.

B. A water service permit is required from the Township prior to constructing any service from the curb stop to the building.

C. All local, state, and other laws and regulations governing blasting.

D. A road occupancy permit must be received from PennDOT (State owned roads) or Buckingham Township (Township owned roads).

1.03 SUBMITTALS

A. Submit shop drawings under provisions of Section 01300.

B. Submit sufficient descriptive literature to demonstrate compliance with these specifications. Include manufacturer's installation, operation, and maintenance instructions.

1.04 PROJECT RECORD DOCUMENTS

A. Legibly mark to record actual depths, horizontal and vertical location of underground piping and appurtenances referenced to permanent surface improvements. The record drawings shall show field changes; changes by change order; and details not on original contract drawings.

B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.05 QUALITY CONTROL

A. Inspection and testing shall be performed in accordance with this section.

B. Prior to covering any portion of the water service, it must be inspected by the Township. No work will be accepted unless it has been inspected and tested. All testing shall be per the pipe manufacturer's specifications.

1.06 NOTIFICATION OF TOWNSHIP

A. The Contractor must notify the Township at least 48 hours prior to beginning operation so that an Observer can be scheduled to be present. Under no condition are operations to commence without this notification and an Observer present.

PART 2 PRODUCTS

2.01 PIPE MATERIALS

A. Ductile Cast Iron Pipe (Service Connection 3" And Larger)

1. Ductile cast iron pipe shall conform to ANSI A21.51 and shall have an ANSI Class 52 thickness unless otherwise specified. All pipe must be AWWA approved (C-100).

2. Ductile iron pipe and fittings shall have a minimum 1/8 inch cement lining with bituminous seal coating in accordance with the ANSI A21.4, latest edition. All pipe shall have bituminous outside coating in conformance with ANSI A21.51, latest edition.

3. Above ground or exposed ductile cast iron pipe shall be flanged in accordance with ANSI A21.10. Buried ductile cast iron pipe shall have flanges (Ansi A21.10); push on joints (Clow Super Bell-Tite or approved equal; or mechanical joints).

4. Ductile iron pipe and fittings shall have mechanical restrained joints or push-on joints, and shall be for 350 psi working pressure with a thickness Class 52 in accordance with ANSI A21.50, latest edition.

5. The pipe will be laid on a 6" stone bedding with select backfill as per Section 02225 of these specifications. The backfill will be compacted and 4' of cover will be maintained over the top of the pipe except as stated otherwise on the plans.

B. Fittings (Service Connection 3" And Larger)

1. Fittings shall in general be of the same material, weight, and class and shall have the same lining and coating as the pipelines in which they are installed.

2. Unless otherwise approved, cast iron flanged fittings and blind flanges shall meet ASA B16.1 standards for Class 125 fittings. AWWA C110 fittings, where shown on the Drawings, shall be Class D. Base fittings shall be provided where shown or required. Where indicated, fittings or specials shall be provided with AWWA Standard lugs.

3. Restrained mechanical joints shall be used at all tees, bends, reducers, and valves. Push-on joints are suitable for all other joints. Mechanical joints shall be Snap-Lock; Push-on joints shall be "Super Bell-Tite" in accordance with ANSI A21.10, latest edition. Joints shall have natural rubber or SBR gaskets as manufactured by Griffin Pipe Products Company or equal.

4. Where flexible pipe couplings are necessary, shall be Dresser Style 53 with coupling bolts of corrosion resistant special alloy "Dresserloy" as manufactured by Dresser Manufacturing Division, Bradford, PA.

5. Ductile iron pipe compact fittings, in accordance with ANSI 21.53, latest edition, may be furnished in lieu of standard joint fittings.

C. Copper Pipe

1. Material:

   a. 1-1/2" and smaller: Type "L" hard.

   b. 2" and Larger: Type "K" hard.

   c. Underground: Type "K" soft.

2. Standards: ASTM B-88

3. Fittings: Wrought copper, ANSI B16.22; dielectric fittings between copper and steel pipe as manufactured by EPCO or equal.

4. Joint material: Silver-solder shall be used on all copper piping.

D. High Density Polyethylene Pipe (HDPE)

1. PE Pipe specifications:

   a. AWWA C901 / ASTM D2737

   b. ANSI/NSF 14 and 61 approved

   c. PE 3608 High Density Polyethylene (HDPE)

   d. SDR 9

   e. Copper Tube Size (CTS)

2. PE pipe connections

   a. Service lines less than 100’ shall be continuous without joints, installed in a straight trench. Service lines longer than 100’ shall be fused.

   b. Stainless Steel Insert Stiffeners

      The contractor shall use stainless steel insert stiffeners as recommended by the valve and manufacture on all PE connections.

3. Tracer Wire

   When using PE tubing the contractor shall install a tracer wire to assist in locating the tubing in the future. The tracer wire installation:

   a. In open trench installations, #12 gauge solid copper tracing wire shall be laid directly on top of the water service. The wire shall be attached to the pipe at a maximum of 20’ intervals.

   b. The trace wire shall begin at the curb box and inside the home when installing service laterals.

c. Wire specifications

1) TWHN solid core

2) Blue color insulation

3) Insulated copper wire #12

d. Continuity tests shall be conducted by the contractor. Testing shall be done in the presence of and to the satisfaction of the Township. Tracing wire installations that fail the continuity testing shall be corrected and retested to the satisfaction of the Township.

4. Curb Box lid with tracer wire connections

The curb box lid shall be equipped with terminals for the tracer wire. It should be noted that all three of the Township acceptable manufactures (Muller, Ford and A.Y. McDonald) have these types of lids.

5. House Penetration / House Grounding

a. The Developer shall submit to Code Enforcement the service water foundation penetration and how the tubing will be sealed, to prevent water entering the home.

b. Since the service water pipe is PE it cannot be used as a grounding source and the Developer will need to supply the Buckingham Code enforcement new grounding details.

2.02 VALVES

A. Gate Valves (Service Connection 3" And Larger)

1. Valves shall be located so that the operators are positioned to be readily accessible for operation. The valves shall be inspected prior to installation, and shall be so installed that they will carry no stresses induced by loads transmitted by adjacent piping. Valves shall be lubricated and ready for service prior to installation.

2. All ductile iron gate valves 3" through 16" shall be resilient seated gate valves, and shall consist of a gate with a bonded elastomer seat, which in the closed position is fully encapsulated and affects a seal upon a cast iron body resulting in a bubble-type seal across this disk at a full differential of 250 psi. The valve shall be equipped with a corrosion-resistant threaded bronze stem, acting through a bronze stem nut fixed into the disk in such a way as to force the disk seat into the body, effecting a seal when the stem is torqued in the desired direction. All internal parts shall be accessible without removing the main body from the pressure line. All ductile iron internal parts shall be coated completely with a bonded epoxy corrosion resistant coating. All outside surfaces of ferrous parts shall be protected with the same fusion bonded epoxy coating and meet ANSA/AWWA C550 standards. The resilient-seated gate valve shall meet or exceed AWWA C509 standards. The valves shall be U.S. Pipe Metro Seal 250*. All gate valves, except those for underground service, shall be of the rising stem type (OS & Y

with handwheel). Buried valves shall have non-rising stems and shall be furnished with a 2 inch operating nut and valve boxes with covers. All valves shall open left. Gate valves 3 inches and smaller shall be bronze-bodied, bronze-mounted, wedge disk outside screw-in yoke construction for 200 pounds static water pressure.

* 5460 for buried service / 5120 for interior service.

B. Valve Boxes (Service Connection 3" And Larger)

1. Valve boxes shall be two-piece screw type cast iron with flared round base. Boxes to be equipped with cover and the word "WATER" cast into the cover. Boxes to be used on each buried valve. Boxes shall be of sufficient length that when installed to the depth of the cover required, they shall be capable of an additional three (3") to full extension.

2. Valve boxes shall be two-piece with 5-¼" diameter shaft, Model H-10360, as manufactured by Mueller Company or equal Tyler.

C. Corporation Stops

1. Corporation stops shall be a minimum of (one) 1" and shall be installed after lines have been flushed, charged with water, and are ready to serve water to customers.

2. When tapping is made at the 10:00 or 2:00 position on the pipe, use a Mueller Company No. B-25008 Corporation stops or approved equal

4. No horizontal (side) or vertical (top) tapping is permitted unless approved by the Engineer.

5. A service saddle will not be required when installing a corporation stop into Class 54 pipe.

D. Curb Stops

1. Curb stop shall be 1" and shall be installed with each corporation stop.

2. Curb stop shall be Mueller B25209 one-inch (1") stops. Curb boxes shall be installed with each corporation stop in accordance with the standard details.

E. Curb Boxes

1. Curb boxes shall be cast iron of sufficient length to reach the surface of the ground, but shall not extend above the surface. The boxes shall have the word "WATER" cast in the lid. Curb boxes shall be Mueller No. H10314 with 89982 lids and stationary rods or approved equal.

2.03 TAPPING SLEEVES AND TAPPING VALVES

A. Tapping valves shall be mounted vertically and shall be of the same construction as described for gate valves, with the exception:

1. Inlet ends of the tapping valve shall have an inlet flange Class 125 and conform to the configuration of the Mueller Company #667

2. Tapping sleeves shall have an outlet flange Class 125. They shall be of the mechanical joint type as manufactured by Mueller Company #H-615 or approved equal.

2.04 WATER METERS

A. General

1. Refer to Section 15406 of these specifications

B. Meter Stops

1. Meter stop shall be 1" copper inlet with swivel nut with Mueller 110 conductive compression couplings. Mueller type H-14258 for key angle meter stops and H-1509-6 for straightway meter stops.

C. Valves for Use with 1-1/2 Inch and 2 Inch Meters

1. Gate valves 2 inches and smaller to be used with copper service pipe shall be brass with non-rising stems and solid wedge disc, manufactured in accordance with ASTM Specification B-62 and Federal Specification W.W.-V54 Class A 125 PSI W.S.P., 200 PSI, W.O.G.

PART 3 EXECUTION

3.01 WATER SERVICE INSTALLATIONS

A. Tapping: All new service lines and, where applicable, service line replacements.

1. All water connection and tapping charges due must be paid before water taps will be made. All replacement water taps are subject to a water tap fee unless otherwise approved by Buckingham Township.

2. Tapping permits for existing lines must be applied for at Buckingham Township, PO Box 413, Buckingham, PA 18912 and paid for at least twenty four (24) hours prior to tapping.

3. All service taps on water mains on existing lines owned or operated by Buckingham Township shall be tapped by a Contractor approved by the Township.

4. No water taps shall be made unless property corners are clearly marked so measurements of taps and curb boxes can be made at the time of tapping.

5. Minimum size tap for water service is one inch (1"). For service line sizes in excess of two inches (2"), the corporation shall be a tapping valve and the curb stop shall be a curb stop box. Taps 4" and larger must be approved by Engineer in writing.

6. Cribbing, sheeting or sloping of the banks of tapping holes, to include holes five feet (5') deep or deeper will be the responsibility of the contractor and will be in accordance with the rules and regulations of the OSHA and Commonwealth of Pennsylvania.

7. Barricading of tapping holes is the responsibility of the Plumbing or Pipeline Contractor and shall be in accordance with the Buckingham Township Engineer for work within the

Township Roads in accordance with PennDOT standards for work within State Highway rights-of-way.

8. Backfilling and compaction of tapping holes shall meet the specifications of the governing body in whose jurisdiction work is being done, i.e., Buckingham Township or Commonwealth of Pennsylvania.

9. Replacement of Existing Corporation Stops: Where an existing corporation stop is to be relocated with a new corporation stop of equal or larger size, then the owner of the property shall be responsible, at his expense, to have the old corporation stop excavated and then contact Buckingham Township, which will shut off the old corporation stop at no expense to the owner. Backfill, compaction and replacing of the corporation stop following shut off by the Buckingham Township is then the responsibility of the property owner at the property owner's expense.

   Abandoning Existing Taps: Where an existing water service is to be abandoned, the owner of the property shall be totally responsible as of these Specifications.

   a. Service lines are generally described as:

      1) The Township's responsibility is from the water main (in the street or alley) to the property line.

      2) The owner's responsibility is from the property line to the facility.

B. Water Service Line Excavations - All new and replacement service lines.

1. Excavation, safety and backfilling, to include proper compaction of nonpotable water service line ditches, are the responsibility of the contractor, all in accordance with the specifications of the governing body in whose jurisdiction the work is being done, i.e., Buckingham Township or the Commonwealth of Pennsylvania. Comply with all OSHA requirements.

2. Water service line ditches must enter the lot as near ninety (90) degrees to the street as is practical and not at an extreme angle unless otherwise approved.

3. Water service line ditches and separation of Water Service and Building Sewer: Except as permitted below, the water service line and the building drain or building sewer shall be not less than ten feet (10') apart horizontally and shall be separated by undisturbed or compacted earth. The water service line may be placed in the same trench with the building drain or building sewer provided the Township approves in writing and the following conditions are met:

   a. The number of joints in the water service line shall be kept to a minimum.

   b. The materials and joints of sewer and water service lines shall be installed in such a manner and shall possess the necessary strength and. durability, to prevent escape of solids, liquids and gases there from. This shall be true under all known adverse conditions such as: Corrosion strains due to temperature changes, settlement, vibrations and superimposed loads.

c. The potable water service line shall have a minimum cover of four feet (4') at all points, and shall be according to the following options:

Option 1: Potable water and sewer trenches shall be ten feet (10') apart horizontally from sewer and non potable water services and shall be separated with unobstructed or compacted earth.

Option 2: The potable water service may be placed on a solid shelf excavated at one side of the common trench a minimum of one foot (1') above the top of the sewer pipe.

d. From the property curb box to the main, the water service pipe shall be type "K" copper.

C. Service Line Installation and Material - all new and replacement service lines.

1. An expansion loop, as approved by the engineer, must be left in the service line where it is connected to the corporation stop at the water main to allow for expansion and contraction. Existing water services or taps which are not 1 inch or larger and/or do not consist of copper, or that will not meet the specifications referred to in this section, will not be permitted. If an existing tap has been deleted from the system at the time of demolition, under no circumstances will Buckingham Township allow a service to be reconnected to a non-conforming tap. The old tap shall be deleted and dressed in with a pup. A new tap may then be made.

2. Potable water service lines shall be a minimum of one inch in diameter.

3. Water service lines between the corporation and the curb stop (Potable Water: one inch through two only) shall be constructed of type "K" copper. Water service lines over 2 inches shall be ductile iron or other Buckingham Township approved material.

4. Water service lines (Potable Water: 1 inch – 2 inch only) shall have only compression joints between the corporation and curb stop. No sweat or welded joints shall be allowed underground. Between the stop box and structure, flared joints of silver brazing joints may be used. No flared joints shall be under a vertical foundation wall or footer.

5. All water service lines from the corporation at the main to the curb stop shall have a minimum of four feet (4') of cover except at the expansion loop unless otherwise approved. Depth of bury shall be determined from finished street grade and finished grade of property being served. No curb stop shall be more than six feet (6') in depth at finish grade.

6. Water service lines shall be installed in a continuous open trench except that in special locations such as under curbs or ornamental shrubs, borings or short tunnels may be used. The Township may specify the use of borings or tunneling to pass obstructions or to minimize traffic interference. Open trenches will be of sufficient width to permit proper installation of pipe materials and compaction of backfill materials.

7. A coarse sand blanket or screenings with a minimum thickness of 4" shall be placed in the trench prior to placing the copper service pipe. Special care shall be taken to insure that copper service lines are not in contact with any rock, cobble, and stones or other

material, which may dent, puncture, deform or otherwise effect the function or life of the installation. Service lines shall be positioned in the center of the excavation prior to backfilling.

8. After installation, a pre-cover of 12" of course sand or screenings backfill shall be placed over the pipe before backfill is placed. When backfill is to be coarse sand or screenings, the pre-cover need not be placed as a separate operation.

9. All service line backfill shall be compacted to the densities specified for trench backfill.

10. Conditions on some replacement projects, including type of service line material and subsurface conditions, may allow the Contractor to "pull" new service lines. Pulling shall be allowed only when specifically approved by the Township. The Contractor shall be responsible for all additional work required should pulling be unsuccessful. Service lines shall be continuous from the main to the meter without couplings or splices.

11. A service line reduced to less than three inches (3") outside a building, must be accomplished by a "wet tap" approved by Buckingham Township or reduced inside the building above floor level unless otherwise approved by Buckingham Township Inspector.

12. Where a one and one half (1-1/2") inch or larger water service line crosses another utility or any underground structure, the potable water service line shall preferably pass over the other utility or structure, but in no instance shall there be less than six inches (6") clearance between the potable water service and the other utility or structure. The space between the potable water service line and the utility or structure shall be backfilled with sand or screenings when the clearance is less than twelve inches (12"). Where a one-inch (1") potable water line passes under a sewer main, it shall be encased in a flexible conduit and Buckingham Township shall determine resolution of larger diameter installations.

13. Water service lines between the curb stop and the building (Potable Water: one inch through 2-inch only) shall be constructed of type "K". No other materials are allowed.

14. All fire service lines (potable water only) shall meet the same requirements as a domestic potable water service line for material and installation specification.

15. Combined commercial fire and domestic services (potable water only) will require additional control valves outside the building, as well as a "wet tap" for any service extension off another service.

16. Residential fire suppression installations must have plans approved by the Buckingham Township Building Inspector.

D. Curb Stop and Curb Box – all new and replacement service lines.

1. All service lines, regardless of size, must have a curb stop valve and curb box installed in accordance with Drawing No.GO-1. The curb box shall be centered over the curb stop and shall be plumb. The curb box shall not be installed in sidewalks or other paved areas.

2. All curb stop boxes will be installed on the property line closest to the public right-of-way and corporation valve, unless designated otherwise by Buckingham Township. (See Drawing No. G0-1.) The stop box shall be three foot 6 inches (3’-6”) in depth at finished grade.

3. The responsibility of the contractor for the curb box ends only when sidewalks, curbs, driveways, etc. have been installed and all backfilling and final grade has been completed and the subdivision is accepted for dedication.

4. After the responsibility of the contractor or all other warranties have ended, Buckingham Township will assume responsibility for repair and maintenance of the "curb box" or secondary valve box.

3.02 WATER METERS

A. General.

1. All water supplied by Buckingham Township to a property must be metered. The only exception to this requirement is fire lines.

2. All residential potable water meters are owned and maintained by the Buckingham Township. The initial residential meter is supplied by the customer at his expense (available for purchase from the Township).

a. Acceptable locations for 1-inch water meters shall be limited to basement, utility room or utility closet unless otherwise approved. Buckingham Township shall approve locations for 1-1/2 inch or larger water meters prior to installation of the water meter loop.

3. All commercial customer meters shall be at the commercial customer’s expense (i.e. purchase, install, maintain and replace as required).

Buckingham Township shall approve locations for 1-1/2 inch or larger water meters prior to installation of the service.

B. Water Meter Installations.

1. Residential potable water meter locations must be in the basement or other lowest level of the building, not to include any crawl space or designated storage area.

2. Water meter locations shall be such that the water meter is unobstructed on one side, i.e., easily accessible for reading or servicing, with a minimum of ten inches (10") clearance around the remainder of the meter with a minimum of three feet (3') of clearance above the meter. Meter locations shall not require stooping or crawling to gain access to the meter.

3. Water meter locations shall include an inlet and outlet valve as shown on Drawing Number GO-4 for single-family homes. Inlet and outlet valves shall be full opening waterway, handwheel operated, compression valves, which shall be installed to close in the direction of the flow.

4. Inside 1-1/2 inch and larger: Plans for inside potable water meter loop (to include support) installations for 1-1/2 inch and larger potable water meter shall be submitted to Buckingham Township for approval prior to installation of the meter loop

C. Combined Domestic and Fire Line Water Meters.

1. Only water meters approved by the National Board of Fire Underwriters shall be installed in potable water lines providing both domestic and fire demands. Requests to install a meter in a potable water line providing both domestic and fire demands shall be submitted and approved by Buckingham Township a minimum of 90 days in advance of construction.

3.03 WATER SERVICE BACKFLOW PREVENTER

A. A water service backflow preventer assembly shall be installed on all residential and non-residential water supply lines and fire services as they enter the building. Backflow prevention devices are to be specified for the specific use. If property use is not specified, RPZ backflow preventers are required. All backflow preventers shall meet the BOCA Code.

3.04 WATER PRESSURE REGULATORS

A. A water pressure regulator designed for 250 PSI shall be installed in all water service lines on the inlet side of the meter. If a pressure greater than the recommended appliance and fixture pressures is required for outside silcocks or sprinkling systems, then a double regulator will be required. Under no circumstances will the pressure exceed 80 PSI at the inlet side of the meter. The regulator should be between the first shut off valve and before the meter.

B. A water pressure regulator for service lines incorporating a 1-1/2 inch or larger meter, where a bypass is required, shall be installed so that the water passing through the bypass is also regulated into the building.

C. A water pressure regulator shall be required with all large meter installations (1 1/2 inch and larger), regardless of type and location, and shall be installed between the first shut off valve and before the meter.

3.05 INSPECTION OF SERVICES - ALL NEW SERVICES.

A. Water service lines shall be inspected by Buckingham Township and the inspection shall include an inspection of the service line from the corporation to the curb stop and an inspection of the meter installation to include all of those items contained within these Specifications.

B. All installations will require inspection of the entire service from the main to meter by Buckingham Township inspector.

C. Commercial properties will require inspection of the entire service, domestic, and fire, from main to meter by Buckingham Township Inspectors.

D. All water services must be visually inspected by Buckingham Township prior to backfilling. The corporation, curb valve and coupling must be left exposed for test. The test shall involve pressuring the service and visually inspecting each joint along the service to insure that there is no leakage.

E. The meter shall not be installed until Buckingham Township Inspectors have witnessed the installation, testing and flushing of the water service.

3.05 INSPECTION OF SERVICES - ALL REPLACEMENT SERVICES.

A. Service Line Repair Due to Leaks. After dedication of the water system and/or connection and expiry of the maintenance bond, Buckingham Township will repair all leaks occurring on a service line between the curb box and tap. The repair of all other service line leaks shall be the responsibility of the property owner.

B. During the installation of any replacement service line, the property owner shall remove any service serving more than one building. Each building must have its own service line and tap.

3.06 REPAIR AND REPLACEMENT OF EXISTING SERVICE LINES.

A. The property owner is responsible for the repair and maintenance of the water service line (the owner shall be responsible for the service line that crosses any private property) from the property line to the facility being served. This is generally from the curb stop to the property being served. If repairs require shutting off the curb stop, property owner must contact Township to shut valve.

B. The "curb stop" shall be defined as the control at the property line or the first valve after connection of the corporation stop or tap valve to a water distribution main, not to include any stops or valves on private mains or services which will be the responsibility of the property owner.

1. Paving cuts made by the plumbing or pipeline contractor shall be drilled, cut or sawed to assure pavement is cut in an approximate straight line and that remaining pavement edges are approximately vertical.

2. Pavement shall not be removed in excess of that amount required to make necessary repairs. Any surface material, trees, shrubbery, fences, poles, grass, crushed rock or other property and surface structures within public or private property which are damaged, removed or disturbed by the plumbing or pipeline contractor, without consent of the owner (public or private), shall be repaired or replaced by the plumbing or pipeline contractor at his expense.

3. All procedures contained in the applicable road opening permit shall be followed.

C. The property owner is responsible for all damages that may occur to other properties, real or personal, including property of the Township, that were proximately caused by failure to repair and maintain the water service line, or from leaks occurring on a water service line or from bursting or other failure of the water service line.

END OF SECTION

SECTION 15406

POTABLE WATER SUPPLY METERS

PART 1 GENERAL

1.01 This specification is for potable water service metering in Buckingham Township. All meters shall be MACH 10® Ultrasonic Meters as manufactured by the Neptune Technology Group. Centerline of meters shall be between 4 and 4.5 feet above the basement floor (See Standard Detail Section). Non-residential establishments requiring larger meters shall use meters supplied by the Neptune Technology Group. The size of the meter shall be approved by the Township.

PART 2. EQUIPMENT

2.01 General

A. All meters, both residential and commercial, shall have an encoder type register for automatic meter reading and shall conform to the following:

1. Encoder system shall include the meter, encoder register, and meter interface unit for remote data collection.

2. Encoder shall be absolute type capable of reading the position of each number/wheel. Pulse type encoders and battery powered units are not permitted.

3. Encoder registers shall be hermetically sealed.

4. Meters shall read in U.S. gallons.

B. The Township has residential meters for sale and will install all meters that are 1 inch and smaller. The meter shall be Neptune with an integrated encoder register with Radio Unit (R900i).

1. Residential meters shall be Neptune® MACH 10®(R900i) ™ Ultrasonic meters.

2. Commercial meters shall be Neptune Mach 10 Ultrasonic meters and have an integrated encoder register with Radio Unit(R900i).

C. Meters larger than 1 inch shall be provided and installed by the Plumber/ Contractor.

1. The meters shall be Neptune Mach 10® manufactured by Neptune and have an integrated encoder register with Radio Unit(R900i).

2. All Fire service meters shall be a Neptune Mach 10 Ultrasonic Meter.

2.02 EXTERNAL BOLTS AND WASHERS

All external bolts and washers shall be or corrosion resistant material and be easily removed from the main case. All threaded main case bolt holes must be covered, to aid in removal of the bolts for repair.

2.02 STRAINERS

All meters must be provided with a corrosion resistant strainer, with an effective straining area at least twice the bore diameter which can be easily removed from the meter without the meter itself being disconnected from the pipeline.

2.03 ACCURACY AND HEAD LOSS TESTS

Meters shall conform to current AWWA C-700, current revision, test flows, head loss and accuracy standards.

2.04 PRESSURE CAPABILITY

Meters shall operate up to a working pressure of 100 pounds per square inch (psi) without leakage or damage to any parts. The accuracy shall not be affected when operating at this pressure due to possible distortion. Accuracy shall not be affected by variations in pressure up to 150 psi.

2.05 PERFORMANCE WARRANTIES

Manufacturer shall guarantee accuracy of all meters for 15 years.

PART 3 EXECUTION

3.01 RESIDENTIAL METER INSTALLATION

A. All meters shall be plumbed and installed in an area that is accessible at all times.

B. Water meter piping shall be independently supported either from wall for floor so the meter can be removed, without disturbing the piping system.

C. All meters shall be installed by Buckingham Township per the standard or sprinkler-equipped residential meter connection detail, in the structure's basement.

3.02 COMMERCIAL METER INSTALLATION

A. All meters shall be installed by the plumber per the commercial meter connection detail, in the structure's basement.

B. Water Meters 1 ½" to 2"

1. Backflow Preventor

a. All new commercial buildings are required Back flow Devices.

b. All new businesses relocating in existing commercial buildings are required backflow devices within 30 days.

c. Devices shall be of the type approved by Buckingham Township.

d. The device must be tested at the time of installation by a State Certified Backflow tester and at the correct intervals for the type of device.

e. Test results are to be sent to:

Buckingham Township
4613 Hughesian Drive
Buckingham, PA 18912

2. Meter Installation

A. All meters should be plumbed and installed in an area that is accessible at all times.

B. Water meter piping shall be independently supported either from wall for floor so the meter can be removed, without disturbing the piping system.

3. Inspection

A. After completion of the installation, the Contractor shall notify Buckingham Township for inspection of the water meter. Then the Township shall witness the inspection of the water meters and, if the inspection is passed, the Township shall seal and register the water meters.

END OF SECTION

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DIVISION 16

ELECTRICAL

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Table of Contents

Overview

Purpose

River Basin Engineering, Inc. (RBEI), who prepared this guideline document, has been instrumental in the design and the review of many wastewater and water systems. Over the years they noticed a great difference in the quality and quantity of information provided by engineering firms to the electrical contractor for construction and the owner (municipality) for review and maintenance.

The vast majority of the electrical plans have had too little design information. This causes an inordinate amount of time spent reviewing the drawings, basically *design is done by review*. The electrical contractor is then forced to fill in the blanks and try to give a fixed price. Because of this, the owner has no idea what he/she is getting and the bid prices are everywhere.

This document has been written to address this concern. By establishing design and construction standards, then everyone in the design/building process knows what is expected. The review process is simplified.

The end result is well planned and constructed, cost efficient job. Remember a well designed job results in a cost efficient job. A small amount of money spent in design can and frequently does result in significant savings during construction.

How to use this Guide

The guide outlines key points for designers and engineers to remember during the preparation of the drawings and specifications. It is intended for the specifications to pick up from where the guide leaves off. Both the **"Municipal Electrical Design Guide"** and **"Municipal Electrical Specifications"** are to be given to engineering design firms by the municipality as a standard for development of the contract documents. The **"Municipal Electrical Design Guide"** and **"Municipal Electrical Specifications"** will also be used during the contract document review.

Each municipality can alter the **"Municipal Electrical Design Guide"** to meet their specific needs. The board of supervisors or council may have to adopt by vote the **"Municipal Electrical Design Guide"** and **"Municipal Electrical Specifications"** as their electrical standards for their municipal facilities.

Please recognize that this publication is a general guide and should be used in conjunction with specific guidance from competent professional engineers experienced in the design and construction industry and familiar with the applicable codes and laws, registered in the Commonwealth of Pennsylvania.

Reviewing Drawings and Specifications

Even though we are coming from an electrical point of view, the questions asked by an electrical designer and engineer should clarify and help define the overall design of the project. A good electrical designer will help establish the sequence of operation or operating method. Mechanically the project can be excellent but if the electrical design does not interface properly with the mechanical design it can ruin the whole project.

In light of the above paragraph, when we review drawings and specifications, we find ourselves asking the same questions over and over again. It is interesting to see most design packages do not effectively communicate the intended electrical design.

We ask the following questions to facilitate our review of the project:

- ***Will it work?***
  - Will the facility actually function from an operator's viewpoint?
  - Will the facility actually perform the intended function as designed?
  - Is the facility going to operate the way the municipality thinks or wants it to?

- ***Can an operator effectively understand and operate the facility?***
  - Is the operation of the facility easily understood?
  - Are the control panels designed for ease of operation?
  - What about an operator, who is not familiar with computers, can he/she run the facility with a minor learning curve?

- ***What fail-safes are built into the sequence of operation to compensate for possible equipment failure and human error?***
  - Obviously you can not prepare for every possible problem but there are some basic fail-safes which can greatly enhance the facilities functionality.

- ***Does the design facilitate future maintenance?***
  - Can the facility be easily maintained?
  - What has to be done for maintenance?
  - For instance, if the PLC went down or was being reprogrammed, can the facility still be run? Does the facility need to be run when the PLC is being worked on or is there enough spare capacity to allow for down times?
  - Another example would be submersible pumps in a wet well. Are the easily removed and replaced? What steps does an operator have to take to remove them? Can he actually do them without help?

- ***What grade materials are being used?***
  - Another way to put this is, how long is facility going to last before the first renovation needs to be done?
  - An upgrade in material can mean additional life expectancy of the facility.

- ***How much are the monthly operation costs?***
  - Is there a different design to lower the monthly cost to operate the facility?

- ***Is the design package easily understood or readable?***
  - Can you see quickly the different parts and pieces or does it all blend together?
  - The information may be there but can you find it?

- ***Can an electrician understand the design package to bid on it?***
  - Is there enough information on the drawings for the electrician to understand what the intended finished product is to be?
  - What holes is the electrician going to have to fill in order to make it work?
  - A good way to see if this has been accomplished is by the bid prices. Are the bid prices grouped together or vastly different?

- ***Does the design conform to local codes, National Electrical Code or other applicable codes?***

- ***Is the municipality getting what it expects?***
  - Does the municipality want total automation? Or are they looking for all manual controls?
  - Does the municipality understand what product the drawings and specifications are going to give them?

Drawings & Specifications

The following list will be checked during a drawing and specification submission review for conformance to the "Municipal Electrical Design Guide" and "Municipal Electrical Specifications". Please note that not all items apply to every project.

Drawings

- All drawings shall be 24" x 36". *This may vary depending on the municipality.*
- Drawings shall be done in AutoCad.
- Upon completion of the project the engineer shall give the municipality (2) sets of as-built drawings and computer generated drawings on disk. The drawings do not have to be in AutoCad. If AutoCad drawing is not acceptable to the engineering firm, than a pdf file will be acceptable, provided that it can be viewed on a computer and printed as a full sized sheet.

The drawings shall include but are not limited to the following:

- Plan views of applicable areas with scale showing the following:
  - All Electrical equipment (electrical meter, panelboards, control panels, disconnect switches, receptacles etc.)
  - Exterior and interior building lighting with related switches.
  - Location and wiring for all control devices (pressure transducers, pressure switches, flow meters, wind monitors, chemical feed tank level sensing, etc.)
  - Mechanical equipment requiring electrical power and/or control wiring.
  - Circuit numbers for all branch circuits.
- Legend
- Site plans of applicable areas with scale showing the following:
  - Building(s)
  - Incoming service
  - Effluent pumps
  - Direct burial feeders, branch circuits and control wiring.
- Drawing specifications (if book specification has not been included)
- Lighting Fixture Schedule
- Power Distribution Diagram or Single Line Diagram
- Schedules for all distribution, power and lighting panels showing circuit number, branch circuit conduit and wire size, circuit breaker size, load, and description.
- Control Wiring Diagrams for aerators, effluent pumps, chemical feed pumps, exhaust fans, auto dialer, etc.

Specifications

The specifications shall include all equipment not specified on the drawings but are not limited to the following:

- *Electrical devices:* Receptacles, GFI receptacles, switches, junction boxes, heat tracing, etc.
- *Distribution equipment:* Panelboards, distribution panels, enclosed circuit breakers, disconnect switches, transformers, etc.
- *Control equipment:* Manual motor starters, NEMA rated motor starters, combination motor circuit protector and motor starter, selector switches, pilot lights, misc. operators and devices, etc.
- *Raceways:* Conduit, conductors, direct burial cable, primary service cable, etc.
- *Stand-by power equipment:* Generator, portable generator, automatic transfer switch, manual transfer switch, etc.
- *Controls:* Control panels, wind monitoring equipment, level sensing devices, pressure sensing devices, timing, devices, programmable logic controllers, enclosures, etc.
- *Lighting:* Lamps, mounting, fixture types, etc.

Sample Specifications

The following sample specifications are included and shall be used as guidelines for the quality of materials to be used and methods of construction:

- Section 16010 General Provisions
- Section 16050 Basic Materials and Methods
- Section 16400 Service and Distribution
- Section 16410 Stand-by Power System
- Section 16500 Lighting
- Section 16900 Controls and Instrumentation

The following lists are items, which have come up often as problems during the review process. Please note that not all items apply to every project.

Incoming Service

General

- Coordinate incoming service with power co.
- Define on the drawings electrical contractors responsibility verses the power co.'s responsibility.
- Where primary service is required, primary cables shall be continuous from the service transformer to power co.'s termination. Sufficient slack shall be provided for power co.'s termination to primary service.
- Service transformer(s), primary service cable(s) and secondary service shall be shown on the electrical drawings.
- When pole mounted transformers are provided by the power co., only the utility pole and secondary service need be shown.
- For a pad mounted transformer installation, provide lightning arrestors on the primary side at the transformer.

480/277 Volt 3Ø, 4W Secondary Service

- The "grounded conductor" shall be installed from the service transformer to the ground bus in the main distribution equipment and grounded as per NEC as if a neutral were being utilized. However, the neutral shall be derived but not used.
- 277 Volt lighting shall not be used for small facilities.

Incoming Main Disconnecting Means

- Provide a main circuit breaker or fused disconnect. Six disconnect rule may be utilized.
- Using a non-fused disconnect or double throw switch shall not be permitted.

Secondary Power Distribution

Transformers

- On 480V systems provide separate step down isolation transformer for controls, system control panel, electronic equipment (flow meters, level sensing equipment, etc.).

Branch Circuit Wiring

- All conductors shall be installed in conduit.
- See Specifications for conduit usages.
- Provide a ground wire in all conduits.

Underground Branch Circuits

- All underground feeders or branch circuits conductors shall be installed minimum of 36” inches deep.
- Underground feeders or branch circuits shall be installed in rigid galvanized steel conduit or PVC conduit encased in concrete.
- Feeders or branch circuits to be installed longer than 100’ may use direct burial cable. See specification 16050 2.01 for type of direct burial cable.

Facility Services

General

- All surface mounted junction and outlet boxes shall be cast type unless indicated otherwise. General duty octagon or squares steel boxes are not permitted for surface mounted junction or outlet boxes.

Telephone

- Provide 2” conduit for telephone cables to enter the building or panel. Conduits shall begin 5’ out from wall or panel and end 1’ above finished floor. PVC conduit is acceptable.
- Show conduit on the drawing.
- In the event the conduit ends in a paved area, conduit shall extend to 5’ beyond pavement.
- Provide an automatic dialer for remote notification of alarms.

Receptacles

- Provide quantity of general receptacles as follows:
  - 150 sq. ft. or less (2) 20A 120V duplex receptacles.
  - 151 to 399 sq. ft. (3) 20A 120V duplex receptacles.
  - 400+ sq. ft. one 20A 120V duplex receptacle every 15’ of wall.
- Provide (2) 20A duplex receptacles at each desk.
- Maximum of (3) outlets per 20A branch circuit.
- Interior areas where piping, pumps and valves are present, all devices shall be surface mounted in cast type “FS” or “FD” boxes with weatherproof covers.
- See specifications Section 16050 2.08 for more details regarding receptacles.

Lighting and Switches

- 15A circuits for lighting and receptacles are not permitted.
- See specifications Section 16050 2.08 for more details regarding switches.
- Interior lighting shall be as follows:
  - Pump, valve and piping areas — Enclosed and gasketed fluorescent fixtures.
  - Labs — 2x4 wraparound surface or troffers
  - General areas — Industrial type fluor. fixt. w/ porcelain reflector

- Exterior lighting shall be pl tube type fluorescent vandal proof fixtures and shall be switch controlled. Pole or building mounted quartz type (switch controlled, instant on/off) may be used for maintenance purposes around wet wells, tanks, etc.

Equipment

Motors/Pumps/Blowers

General

- For all motors 20HP and larger provide solid state starters or variable frequency drives.
- Controls for all motors shall include ammeter, running pilot lights, hand/off/auto selector switches.

Vertical Turbine Pumps

- Provide heat tracing for the bearing cooling water piping.
- Provide a low water cut-off below the normal operating low water shut-off for pump protection.
- Provide wiring for winding heater with control diagram.

Submersible Pumps

- Provide control wiring and pilot lights for temperature and moisture sensors. Coordinate with Pump manufacturer.

Stand-by Power

General

- The municipality shall determine whether a portable or permanent generator shall be utilized for stand-by power for the wastewater pump stations.
- Disconnecting means shall be provided for each item on the load side of the transfer switch (manual or automatic). For example panelboard, pump control cabinet, transformer etc.

Portable Generator

It is not recommended to use a portable stand-by system. Unless the generator is small a portable stand-by system can be hazardous for maintenance personal to operate and transfer from site to site.

If the municipality desires this type of stand-by power, we will work directly with them to produce specifications for a safe installation and operation. We do not include a general specification for portable stand-by systems for that reason.

However we have included the following design guidelines:

- Double throw manual transfer switch shall be rated to “make and break under load”.
- Transfer switch shall be sized according to the incoming service not the portable generator. In the event the portable generator is larger than the incoming service and transfer switch, provide an enclosed circuit breaker between the generator receptacle and transfer switch, sized to protect the transfer switch and distribution system.

- On stand-by side of the manual transfer switch, provide a weatherproof receptacle placed at a convenient place outside the building or on the site. Receptacle configuration shall be coordinated with local municipality.
- Manual transfer switch shall not be used as a service entrance disconnecting means.

Permanent Mounted Generator

- See specifications Section 16410 for details.

Transient Voltage Surge Suppression System (TVSS)

- Provide TVSS as specified in Section 16400 2.04. for all facilities.
- TVSS are intended to be computer room grade to protect the electronic equipment for facilities utilizing programmable logic controllers and other sensitive electronic equipment.
- Provide TVSS on the following:
  - Main Distribution Panel or Circuit Breaker.
  - All panelboards or distribution panels on the load side of a step down transformer.

Enclosures and C-Channel

- All exterior enclosures and equipment shall be NEMA 4X stainless steel or fiberglass (krydon).
- All wireways shall be stainless steel: NEMA 1 Indoors and NEMA 4X Exterior.
- All interior enclosures may be NEMA 1, except where stated otherwise.
- Interior control system cabinets shall be NEMA 12.
- Exterior and Interior C-channel shall be stainless steel.

Rooms/Areas

Chemical Feed

- All equipment within close proximity (8' diameter around the tank(s)) of the chemical feed equipment shall be corrosion proof and rated NEMA 4X. In the event a room of 100 sq. ft or less is utilized, all the equipment in the whole room shall be corrosion proof and rated NEMA 4X. PVC conduit and fiberglass boxes shall be utilized in these areas.
- Chemical feed pumps shall have a receptacle controlled by a hand/off/auto selector switch. In "hand" the chemical feed pump shall run manually. In "auto" the chemical feed pump shall be subject to the system control panel.
- Chemical feed systems shall provide a low chemical signal to the system control panel for alarm and system shutdown.

Screen Room

- A room with a screen (rotating bar screen or fixed) shall have an electrical classification of Class I Div. 2.
- Screen Room shall be heated for freeze protection.

Wastewater Treatment Plants

Spray Irrigation System Controls

For spray irrigation wastewater treatment plants (SIWTC) controls are required to coordinate all the parameters and equipment. Provide for the following items in the design and specification of the control panel:

- *Shop Drawings* shall be submitted in a 3 ring binder with dividers before construction and shall include the following:
    - Sequence of Operation
    - Catalog data sheets for all components used to construct the panel.
    - Complete ladder wiring diagram showing devices, wiring and terminal blocks numbered and labeled.
    - Program for the PLC.
    - Front panel and interior arrangement drawings.
    - All wire sizes for power distribution.
- See Municipal Specification 16900 for specifications of individual components.
- Submit sequence of operation for approval during design.
- Front panel devices shall include but not limited to the following:
    - Auto/off/manual selector switches, running pilot lights, ammeters, elapse time meters, trouble pilot lights for all pumps.
    - Open/close selector, open/close pilot lights for all automated valves.
    - LCD readouts for system pressure, flow (gpm), level in storage lagoon.
    - Wind Monitor as specified in Section 16900 2.09. *Wind monitoring is not required in all municipalities.*
- In the event the control panel requires maintenance, manual controls must be available to run the plant.

Sequence Batch Reactor

- Coordinate with manufacturer and show all electrical items not provided by manufacturer.
- Provide cable schedule for branch circuit wiring for all items fed from SBR control cabinet.
- Heat trace all piping between tanks. This primarily applies to a steel tank type SBR.

Aerators

- Provide a disconnect switch with receptacle for each aerator. Provide matching plug for vendor supplied cable from each aerator. See attached receptacle color codes.
- If the aerator has a heater to keep it from freezing, provide disconnect switch, receptacle and plug as described above.
- If the aerators have heaters, provide a control system for temperate control of the heater. *This control system is not required in all municipalities.*

General Check List

- Influent and Effluent Flow Meter with associated chart recorders.

Wastewater Pump Station

Duplex Pump Control Panel

- Coordinate with manufacturer and show all electrical items necessary for complete installation not provided by manufacturer.
- Show on the drawings branch circuit and control wiring for all items fed from control cabinet.

General

- If the municipality does not require a building, all electrical equipment shall be enclosed in one or more free standing stainless steel NEMA 4Xenclosures.
- Provide detail(s) showing the conduit and wire entrance for pump power and controls and level controls. Design for easy future maintenance.

SECTION 16010

GENERAL PROVISIONS

PART 1 GENERAL

1.1 NOTICE

A. The General Conditions, Special Conditions, General Requirements and Drawings are hereby made a part of this Section as fully as if repeated herein. Contractor shall consult these sections in detail as he will be responsible for and governed by conditions set forth therein and work indicated.

B. Attention is directed to other sections of the specifications, which affect the work under this section.

1.2 JOB CONDITIONS

A. The Contractor shall visit the site and familiarize himself with all existing and limiting conditions that have a bearing on his work. Failure to do so will not relieve him of any subsequent responsibilities pertinent to this project.

B. The Contractor shall coordinate with all other trades for proper interface and installation of all electrical items indicated or specified. The Contractor shall coordinate with the Masonry Contractor for the installation of all conduits and devices in masonry walls.

1.3 PERMITS AND INSPECTIONS

A. Permits and licenses necessary for the execution of this work shall be secured and paid for by the Contractor.

B. Contractor shall arrange for all inspections specified herein or required by all agencies having jurisdiction and furnish required certificates of inspection to Owner, including electrical certificate from State licensed agency.

1.4 CODES AND STANDARDS

A. The installations shall conform with all applicable codes and standards. The construction of the systems indicated and called for in these specifications shall be performed in accordance with standard practices, except as otherwise indicated or specified. The Contractor shall be responsible for obtaining the necessary information to comply with these requirements. Any modification of the drawings or specifications that may be necessary to meet these requirements must be approved by the Engineer or authorized representative before they are made.

B. The Contractor shall give all notices and comply with all laws, ordinances, codes, rules and regulations bearing on the conduct of the work as drawn and specified. If the Contractor observes that the drawings and/or specifications are at variance therewith, he shall promptly notify the Engineer in writing of any necessary changes of work. If the Contractor performs any work knowing it to be contrary to such laws, ordinances, codes, rules, and regulations and without such notice to the Engineer, he shall bear all costs arising therefrom.

C. Requirements of the following organizations shall be considered minimum:

1. National Electrical Code
2. National Electrical Safety Code
3. Local Utility Company
4. Local Telephone Company
5. OSHA
6. Local City and County Codes

1.5 ELECTRICAL ABBREVIATIONS, REFERENCES AND DEFINITIONS

A. Abbreviations and symbols herein and on Drawings are in accordance with ANSI Standard Y1.

B. References to technical societies, trade organizations and governmental agencies in the Electrical Division are in accordance with the following:

1. ANSI - American National Standards Institute
2. ASTM - American Society for Testing Materials
3. IEEE - Institute of Electrical and Electronics Engineers, Inc.
4. NEC - National Electrical Code
5. NEMA - National Electrical Manufacturers Association
6. NFPA - National Fire Protection Association
7. OSHA - Occupational Safety and Health Administration
8. UL - Underwriters' Laboratories, Inc.

C. The following definitions of terms and expressions are applicable to the Electrical Division.

1. "Provide" shall mean, "furnish and install."
2. "Herein" shall mean "contents of a particular Division" where this term appears.
3. "Indicated" shall mean, "indicated on Contract Drawings."

4. "Equal" shall mean, "approved equivalent."

5. "Contractor" shall mean "Contractor or subcontractor for work described."

1.6 TESTS

A. Arrange and pay for all tests. Notify Engineer three (3) working days before tests are made. Conduct tests in presence of Engineer or authorized representative. Repeat tests after defects are corrected.

B. Prior to tests, provide feeders and branch circuits continuous from main distribution panel to outlets, fixtures and equipment.

C. Demonstrate system is free from short circuits and properly grounded.

D. Test lighting circuits for correct operation after lamps are installed.

E. Check all motors for correct rotation.

F. Test load balance as specified herein.

1.7 SYSTEM OPERATION INSTRUCTIONS

A. Verbal Instruction

1. After all tests and adjustments, Contractor shall instruct attendant or Owner's representative in all details of operation of distribution.

2. Supply attendants to operate the systems until Engineer is satisfied that the systems have been installed in accordance with these Drawings and Specifications and are functioning properly.

3. Provide services and equipment manufacturer's engineer to instruct representative of Owner in operation and maintenance of Electrical equipment.

B. Written Instruction

1. Provide two (2) copies of printed instructions and diagrams covering operation and maintenance of each item of equipment in accordance with Division 1, Sections 01340 and 01700.

2. Instructions furnished in bound covers and posted at locations designated by Engineer or authorized representative.

1.8 LAYOUTS

A. Electrical system layouts indicated are generally diagrammatic and location of outlets and equipment is approximate; exact routing of raceways, locations of outlets and equipment shall be governed by structural conditions and obstructions. This is not to be construed to permit redesigning systems; all outlets and equipment shall be interconnected as indicated. Locate and install equipment requiring maintenance and operation so that it will be readily accessible. Any relocation of outlets or equipment

must be approved by the Engineer or authorized representative before erection. The right is reserved to make any reasonable change in location of outlets and equipment prior to "roughing-in" without involving additional cost.

B. Coordinate the installation of wiring, raceways, outlet boxes, sleeves, anchors, and other concealed or embedded items so that this work is properly in place before concrete or partitions are in place.

1.9 SHOP DRAWINGS

A. The Contractor shall submit within 15 days after the award of the contract a list of materials required for the project. This list shall be complete and include all items or systems called for in this contract. Partial lists submitted from time to time will not be acceptable. The list shall identify the specific item, manufacturer, and vendor. Vendor information only will not be acceptable.

B. After approval of the material list, the Contractor shall secure descriptive drawings or catalog cuts of equipment to be furnished under his contract. He shall review these Shop Drawings for conformance to contract documents prior to submission to Engineer. No equipment shall be ordered until they have been reviewed by the Engineer and found to be in conformance with the Contract Documents.

C. Shop Drawings shall be in accordance with General Conditions and Supplementary General Conditions of these Specifications.

D. All Shop Drawing submittals shall have the following identification data, as applicable, contained therein or permanently adhered thereto:

1. Project name
2. Project number
3. Subcontractor's Vendor's and/or Manufacturer's name and address
4. Product identification
5. Applicable contract drawings and specifications section number
6. Shop Drawing title, drawing number, revision number, and date of drawing and revision

1.10 SUBSTITUTES

A. Manufacturers' names and catalog numbers of materials and equipment are given to describe type, quality and design of material and equipment required. Where possible three (3) or more manufacturers are listed.

B. Where materials or makes are specified and where the words "or equal" or "approved equal" are not used, only the makes specified shall be furnished and installed.

C. Where "or equal" is used, written request for substitutions shall be submitted for approval in ample time, but no less than ten (10) days prior to bid date to permit checking and appropriate action. If approved, an Addendum will be issued. No request for substitution will be considered later than ten (10) days before bids are due.

D. Where "or equal" is used followed by manufacturer name(s), indicates manufacturers with acceptable deviations from the specified product which may require changes to the installation.

E. In the event that an "or equal" manufacturer is used the contractor shall be responsible for any additional cost incurred as a result of the deviations in using the "or equal" product.

1.11 MATERIALS AND EQUIPMENT REQUIREMENTS

A. Provide materials and equipment conforming to those specified herein. Manufacturers' names and catalog numbers are given to describe type, quality and design of material and equipment required.

B. All material and equipment shall conform to capacity, efficiency, design and material specified and shall meet dimension and space requirements. Sizes of materials and equipment indicated or specified are minimum requirements. The Contractor may use larger sizes to expedite the work provided that such change meets space requirements and does not result in additional installation, maintenance or operating cost to the Owner. Equipment or materials of the same type or classification, used for the same purpose, shall be the products of the same manufacturer.

C. All materials shall be new, of the best of their respective kind and shall conform with accepted standards of the trade in every case where such a standard has been established for the particular type of material in question. Equipment and accessories not specifically described or identified by manufacturer's catalog numbers shall be designed in conformity with applicable technical standards and specification of societies, organizations and/or agencies listed herein, suitable for maximum working pressure and shall have neat and finished appearance.

D. Materials and appliances of types for which there are UL standard requirements, listings or labels shall have such listing of UL, be so labeled, and shall conform to their requirements.

E. In all cases where a device or part of the equipment is herein referred to in the singular number, it is intended that such reference shall apply to as many such items as are required to complete the installation.

F. Contractor shall, without charge, replace any work or material, which develop defects, except ordinary wear and tear, or fail to perform satisfactorily, within one (1) year from the date of final acceptance.

1.12 TEMPORARY POWER AND LIGHT

A. Provide outlets and circuits for light and power during progress of construction. Provide ample receptacles for tools up to 1/2 hp as directed by General Contractor. All wiring and outlets shall conform to NEC and OSHA requirements for construction sites. Provide temporary lighting of the levels as directed by OSHA in all areas requiring lighting for construction. Minimum service shall be 1-200 ampere service. Location shall be as directed by the General Contractor.

B. Temporary power shall be separately metered.

1. Arrange for, pay all connection and disconnection costs, if any, charged by the Power Company.

2. General Contractor will pay for power consumed.

PART 2 PRODUCTS

Not Applicable

PART 3 EXECUTION

Not Applicable

END OF SECTION

SECTION 16050

BASIC MATERIALS AND METHODS

PART I GENERAL

1.01 SCOPE

A. Provide material and perform all work as outlines in this Section for all basic material and methods required in the installation of the electrical work. Such work includes, but is not limited to, the following:

1. (This scope should be written for each job.)

1.02 SUBMITTALS

A. Furnish shop drawings and descriptive data, complete with project designation for the following:

1. Wiring Devices
2. Disconnects
3. Direct Burial Cables
4. Supports and Hangers
   a) Provide sketches of proposed equipment racks, if not detailed on drawings
   b) Provide itemized list of all components.

PART 2 PRODUCTS

2.01 DIRECT BURIAL CABLE

A. Power and Control

1. Type MC-600V 90°C-dry or WET, multi-conductor Type XHHW insulated copper conductors, bare copper ground.
2. Cable shall comply with UL 1569 Type MC Metal-Clad cable.
3. Armored protection shall be a continuously wielded impervious corrugated aluminum outer sheath with polyvinyl chloride jacket.

B. Instrumentation

1. Type 300V - 105°C rating PLTC Armored Thermostat Instrumentation Cable. Multiple twisted shielded pairs or triads.
2. Minimum size conductor #16 AWG.

3. Armored protection shall be a continuously wielded impervious corrugated aluminum outer sheath with polyvinyl chloride jacket.

C. PLC Communications Cable (Direct Burial)

1. The DH + data highway cable shall be a multi-Conductor, 1 twinax (2 conductors), 20 AWG, stranded (7x28) TC - Tinned Copper conductors, PE - Polyethylene insulation, Polyester Tape-Aluminum Foil (Beldfoil) shield with 20 AWG stranded (7x28) tinned copper drain wire and 100% shield coverage plus tinned copper Braid shield with 55% shield coverage, PVC - Polyvinyl Chloride jacket, continuously Corrugated Armor, overall PVC - Polyvinyl Chloride jacket. Belden #189463 or approved equal by Allen Bradley.

2. Applicable specifications: UL Type PLTC. Flame Rating: UL 1581 Vertical Tray (70,000 BTU/HR). 78-Ohm Twinax. BELDFOIL is a Belden registered trademark. BLUE HOSE is a Belden registered trademark.

D. Fittings shall be watertight furnished with neoprene gasket and insulated bushings, OZ Gedney, T&B or Appleton Electric.

E. Manufacturers: Okonite C-L-X Type MC (XHHW) or approved equal (Power and Control), Okonite C-L-X Type SP-OS or approved equal (Instrumentation).

2.02 CONDUCTORS

A. Copper Conductors:

1. Copper single or multi-conductor 600 volts THWN/THHN insulated.

2. Minimum wire size for branch circuits shall be #12 AWG except nonload carrying control circuits may be No. 14 AWG.

3. Manufacturers: Cablec, ITT-Royal, Southwire or Okonite.

2.03 CONDUITS

A. Galvanized Rigid Conduit:

1. Material: Hot dipped galvanized rigid steel.

2. Fittings: Cast metal, screwed fittings; 1-1/2” and larger, mogul type. (Zinc coupling or nonferrous metal fittings are not acceptable).

3. Standards: ANSI C80.1, ANSI C80.4.

4. Manufacturers: Spang, Triangle, Wheatland or Allied.

B. Rigid Aluminum Conduit:

1. Material: Aluminum

2. Fittings: Cast copper-free aluminum screwed fittings: 1-1/2” and larger, mogul type.

3. Standard: UL listed and labeled.

4. Manufacturers: Anaconda, American Brass Co., Kaiser, Reynolds Metal Co.

C. Polyvinyl Chloride Conduit:

1. Material: Schedule 40, 90°C wire rated polyvinyl chloride rigid conduit with minimum wall thickness of 0.237".

2. Fittings: Coupling type.

3. Joints: Connections shall be made by solvent welding.

4. Standards: NEMA, UL, NEC, ASTM D1784.

5. Manufacturers: Carlon EPC-40-PVC, Triangle, and Robroy.

D. Liquid-Tight Flexible Metallic Conduit:

1. Flexible galvanized steel core with continuous copper ground in the convolutions covered with extruded polyvinyl chloride.

2. Connectors: Nylon insulated screw in ground core type connectors constructed of malleable iron Thomas & Betts Liquid-tight fittings or equal.

3. Manufacturers: Triangle, Electri-Flex or Robroy.

E. PVC Coated Galvanized Steel Pipe

1. Zinc coated steel conduit with 40 mil PVC exterior coating and 2-mil urethane interior coating.

2. Fittings: Form 7, Zinc coated steel conduit with 4- mil PVC exterior coating and 2-mil urethane interior coating. For 1-1/2" and larger use mogul type.

3. Standard: UL listed and labeled: Standard #6.

4. Manufacturers: Robroy Industries "Plasti-bond" series or approved equal.

2.04 OUTLET BOXES & FITTINGS

A. Sheet Metal Boxes:

1. Non-gangable 14 gauge galvanized steel knockout type. Minimum size shall be 4" x 2" deep unless otherwise specified. Boxes shall be 4-11/16" deep when served with one-inch conduit.

2. Wall boxes for use in concrete wall shall be a minimum of 2-1/2" deep, suitable for use in concrete construction, one piece, nonload gangable sheet steel.

3. Manufacturers: Allied Metal, Steel City, RACO, Appleton or equal.

B. Non-Metallic Outlet Boxes, Fittings & Junction Boxes:

1. Boxes shall be constructed of either high temperature PVC or polyester with reinforcing fiberglass.

2. Enclosures shall be NEMA 4 or 4X.

3. Screw covered boxes shall use stainless steel screws and brass threaded inserts in box.

4. Hinge covered boxes shall use either non-metallic or stainless steel hinges and latches.

5. Manufacturers: Carlon, Stahlin Bros., Hoffman, or Crouse Hinds.

C. Cast Boxes, Fittings and Conduit Bodies:

1. Standard general purpose cast aluminum type with threaded conduit entry, gaskets and covers.

2. Choice of body types shall be made to conform to installation requirements.

3. Aluminum metallic finish.

4. Manufacturers: Crouse Hinds, Appleton or Killark.

2.05 JUNCTION AND PULL BOXES

A. Smaller than 150 cubic inches: Standard outlet boxes with cover.

B. 150 cubic inches and larger: Construct same as cabinets and conforming to UL "Standards for Cabinets and Boxes".

C. Junction and pull boxes shall be:

1. NEMA Type 4X enclosure.

2. Cast copper face aluminum alloy.

3. Stainless steel cover bolts and neoprene gaskets.

4. Conduit openings shall be factory installed.

5. Manufacturers: Killark DBS series or equal, Crouse Hinds, Appleton and Hoffman.

2.06 CONNECTORS AND INSULATING TAPE

A. Connectors:

1. Conductors No. 8 and larger terminated and spliced with Burndy or T&B mechanical pressure connectors.

2. Conductors No. 10 and smaller terminated and spliced with insulated expandable live spring type twist-on compression type connector.

3. Connect conductors to apparatus by means of approved lugs or connectors as manufactured by Thomas & Betts or equal.

B. Insulating Tape:

1. Vinyl plastic insulating tape, 7 mil thick, Scotch 33+ or equal.

2. Apply at all joints and splices.

2.07 TAGS AND NAMEPLATES

A. Identify electrical conductors in boxes and cabinets with letters and numerals as manufactured by W.H. Brady, Cat. No. B-500 vinyl or equal with prior approval. Letters and numerals shall be black printing on a white vinyl background, 0.006 inches thick. Identification includes circuit number and panel designation.

B. Provide laminated plastic nameplates, black background, with ¼" engraved white lettering with 2 each 3/16" holes for attachment with ¼" No. 6 self-tapping sheet metal screws.

1. Panelboard nameplate shall be 4" x 1-5/8" x 1/16".

2. Motor controls and equipment: 2-1/2" x ¾" x 1/16".

C. Panelboard nameplate shall include voltage and phase identification.

2.08 WIRING DEVICES

A. Wall switches: Hubbell No. 1221, 1222, 1223, and 1224, 20 ampere 120/277 volt, quiet type, brown bakelite housing, back and side wiring, single pole, two pole, three way or four way as indicated.

B. Convenience outlets: Hubbell No. 5362 Series duplex type for grounding 20 ampere, 125 volt, break off terminals for switch control or split circuiting, colors to match switches. No. GF-5362, 20 ampere, 125 volt, ground fault circuit interrupter duplex receptacle.

C. Wall plates: Hubbell Series "PX" smooth finish brown thermoplastic plates. Weatherproof type; Crouse-Hinds WLRD-1, self-closing spring doors, gasketing, die cast copper-free aluminum construction, epoxy finish, GFCI wet location type; Hubbell WPF526 die cast aluminum for FS box mounting.

D. Manufacturers: Hubbell, Arrow-Hart or Bryant devices comparable to those listed herein:

2.09 EQUIPMENT SUPPORTS AND STANDS

A. Rigid metal conduit shall be supported in accordance with Article 346-12 of the National Electrical Code.

B. Conduits shall be supported by galvanized Unistrut or Kindorf channels and straps, or equal, with prior approval, or by beam clamps fastened to building steel. All cut edges of galvanized channel shall be recoated with Zinc Rich or equal.

C. Where steel supporting channels are fastened to masonry walls, toggle bolts, expansion shields or through bolts shall be used. Wood plug masonry anchors shall not be used.

D. The use of perforated iron straps for supporting conduits will not be permitted.

2.10 DISCONNECTS

A. Construction:

1. Type: NEMA heavy duty Type DH, non-fused, except as indicated otherwise.

2. Terminal lugs: UL listed for copper cables and front removable.

3. Switch blades: Blades shall have quick make and quick break operating handle with dual cover interlock to prevent door opening in “ON” position.

4. Enclosure: NEMA 1 indoor, NEMA 4X outdoors, NEMA 4X in screen room.

5. Electrical interlock: One normally open contact on all switches on equipment served by power and control wiring.

B. Manufacturers: Square D “Heavy Duty”, or equal Cutler-Hammer, or ITE.

2.11 WIREWAYS

A. Construction of all wireways shall meet or exceed NEC 376. Number of Conductors per cross section shall conform with NEC 376.22.

B. All wireways shall be constructed of stainless steel (non-magnetic, 302) with welded seams.

C. Uses:

1. Indoor – NEMA 1 or 12.

2. Outdoor – NEMA 4X.

2.12 DH+ DATA HIGHWAY CABLE

A. The DH + data highway cable shall be a multi-conductor, 1 twinax (2 conductors), 20 AWG, stranded (7x28) TC - Tinned Copper conductors, PE - Polyethylene insulation, Aluminum Foil-Polyester Tape (Beldfoil) shield with a 20 AWG stranded (7x28) tinned copper drain wire and 100% shield coverage plus tinned copper Braid shield with 55% shield coverage, PVC - Polyvinyl Chloride jacket. Belden #9463 or approved equal.

B. Applicable Specifications: UL Type CM, CL2, AWM 2464, CEC C(UL) CM, Allen Bradley P/N 1770-CD P-7K-SC-182006-2-MSHA. Flame Resistance: UL 1581 Vertical Tray. Blue Hose Cable for DH and DH+ Systems. 78 Ohm Twinax. Coaxial. Industrial Automation & Process Control Cables. Industrial Twinax Cables. Pennsylvania Department of Environmental Resources and United States Mine Safety and Health Administration Certification. Recommended for RF applications requiring a cross talk free, balanced operation. BELDFOIL is a Belden registered trademark.

PART 3 EXECUTION

3.01 CONDUIT CLASSIFICATION

A. Rigid galvanized conduit shall be used for the following:

1. Wiring installed underground, in concrete slabs, and in masonry walls, except as indicated otherwise.

2. Main secondary service underground raceway, feeder conductors servicing lighting and power panels, except as indicated otherwise.

B. Rigid aluminum conduit may be used for wiring specified to be in rigid galvanized where conduits are not in contact with concrete or installed underground.

C. Liquid-Tight metal conduit shall be used as follows:

1. For final connections to motors or other equipment subject to motion or vibration (length: 2 ft. max.).

2. For final connections to unit heaters and exhaust fans.

D. Nonmetallic rigid plastic conduit ("PVC") shall be used as follows:

1. For chlorine room and screen room.

3.02 CONDUIT INSTALLATION

A. Install conduit in accordance with the following:

1. All conduits are to be installed concealed where applicable. Minimum size conduit shall be ¾". Other sizes shall be as indicated or required by the NEC for number and size of conductors installed.

2. All conduit joints shall be cut square, threaded, reamed smooth, and drawn up tight. Bends or offsets shall be made with Standard conduit ells, tied bends made with an approved bender or hickey, or hub type conduit fitting. Number of bends per run shall conform to NEC limitations. All exposed field and factory-installed threads are to have two coats of Zinc-Riche's ZR or Zink-X applied after threads are cleaned of oil and grindings.

3. Concealed and exposed conduits shall be run with long sweep bends and offsets (parallel to and at right angles to building lines).

4. Conduits shall be continuous from outlet to outlet and from outlets to cabinets, pull or junction boxes, and shall be secured to all boxes with locknuts and bushings in such a manner that each system shall be electrically continuous throughout. Conduit ends shall be capped to prevent entrance of foreign materials during construction.

5. Conduit terminals at cabinets and boxes shall be rigidly secured with locknuts and bushings as required by the NEC. On all conduit 1-1/4" trade size and larger, bushings shall be of the installed or insulating with double locknut type

as manufactured by Thomas & Betts or approved equal.

6. Conduit side entries into service cabinet shall be made with flanged unions for continuous raceway passage through cabinet wall.

7. All underground conduits entering service cabinet shall be effectively sealed to prevent water moisture or any other foreign matter from entering.

8. Underground conduit system shall consist of wide sweep elbows and bends and shall be completely watertight. Unless noted otherwise, conduits shall be not less than 30" below finish grade for cables 600-volts and not less than 36" below finish grade for cables above 600-volts.

9. Routing of all underground conduits to be identified by placing a continuous plastic tape in the trench backfill six to eight inches below finished grade. The tape is to be non-biodegradable type plastic at least 4" wide, yellow in color, and imprinted with the legend "Caution - Buried Electric Line Below".

10. PVC coated conduit systems, fittings and boxes shall be installed as per manufacturer's instructions using manufacturer's tools and touch materials.

3.03 SUPPORTS AND HANGERS

A. Design and construct supporting structures of strength to safely withstand stresses to which subjected and to distribute properly the load and impact over building.

3.04 JUNCTION PULL AND OUTLET BOX INSTALLATION

A. Sheet metal boxes shall only be used for flushed mounted applications of devices or junction boxes in walls or ceilings.

B. Cast boxes shall be used for surface mounted or exterior applications of devices or junction boxes on walls, ceilings or exterior location.

C. Install boxes approximately as indicated:

1. Set boxes true and rigidly secure in position.

D. Provide boxes of sizes and types to accommodate the following:

1. Structural conditions

2. Size and number of conductors or cables entering

3. Device or fixture for which required.

E. All boxes mounted outdoors and in Chlorine Room shall be non-metallic.

3.05 CONDUCTOR INSTALLATION

A. Install conductors of size and number indicated or required in accordance with requirements of NEC.

1. Do not draw conductors into conduit until conduit is free from moisture.

2. Leave sufficient slack to permit connection of fixtures, switches and equipment without additional splices; 8” minimum.

3. Minimum wire size for branch circuits shall be #12 AWG except that home runs longer than 100 feet from panel to load shall be minimum #10 AWG.

4. Each motor shall be supplied by an individual branch circuit.

B. Make taps and splices in wire as follows:

1. Conductors shall be square cut with a hacksaw or cable cutter without deforming the strands. Insulation shall be removed with a penciling cut to avoid nicking the strands and surface oxides shall be removed by brushing exposed strands with a wire brush or card file. Where conductor bends are less than 8 times cable diameter, foregoing operations shall be done after bending.

2. Compression connectors shall be selected to fit the conductor.

3. Splice only in accessible pull, junction or outlet boxes.

4. Use mechanical wire splices and joints for #8 wire and smaller and AL/CU pressure connectors for #6 wire or larger.

5. Insulate joint at least 100% in excess of wire insulation.

3.06 GROUNDING

A. Ground neutral of service and non-current carrying metallic parts of electrical system to service grounding system.

1. Service to be grounded to ground rod and water service main.

2. Metallic parts to be grounded shall include cabinets, panelboards, conduit, outlet boxes, motor frames, control panels, transformers, and generators.

3. Bond with suitable ground clamps.

4. Provide all wiring, grounding conductors and grounding devices required to comply with NEC.

B. Provide maximum resistance of 10 ohms or conform with requirements of Power Company.

3.07 CUTTING AND PATCHING

A. All cutting of concrete or other material for the passage of conduit shall be done by the Contractor where necessary to install his work. Contractor will close all such openings around conduit with material equivalent to that removed. All exposed surfaces shall be left in suitable condition for refinishing without further work.

B. Where conduit passes through fire rated walls and floors seal opening with fire resistant elastic adhesive compound.

C. No structural member shall be altered or cut without the special permission of the Engineer.

3.08 WIRING DEVICES

A. Where devices are indicated, install device complete with metallic outlet box. Ground connections between device and outlet box are required on both standard and self-grounding devices equipped with a ground terminal.

3.09 EXCAVATION AND BACKFILLING

A. Contractor shall perform all necessary excavation and backfilling required for the installation of their work.

B. Excavate bottom of trenches to exact depth, refill excavation below required grade of cable or raceway with firmly compacted sand. Deposit excavated materials on side of trench; do not leave material where it will interfere with traffic. Suitably protect trenches and openings with signs, barricades, enclosures or flashing lights.

C. For conduit installation, backfill with good fine earth, free from cinders, stones or brickbats. Apply fill in 10” layers and carefully tamp. Restore finished areas to their original condition.

D. For direct buried cable provide 4” deep sand bedding below cable and backfill with well-tamped sand 4” above cable, then proceed as in “C” above.

END OF SECTION

SECTION 16400

ELECTRICAL SERVICE AND DISTRIBUTION

PART 1 GENERAL

1.01 DESCRIPTION

A. Perform all work necessary and/or required and furnish all materials and equipment for a complete system of electrical service and distribution. Such work includes, but is not limited to, the following:

B. Remove electrical service from Power Co.'s Transformer to Control Building.

1. Provide new primary and secondary service system for power distribution for light, power including dry type transformers, panelboards and circuit breakers, safety switches, switches, receptacles, conduit, and wiring in proposed control building.

2. Provide new branch circuits in control building.

3. (This scope can be written to accommodate each job.)

4. Consult Section 16050 for work, materials, and methods specified in that Section.

1.02 SUBMITTALS

A. Furnish Shop Drawings and descriptive data, complete with project designation, for the following:

1. Panelboards and Circuit Breakers

2. Dry Type Transformers

3. Transient Voltage Surge Submission System

4. Enclosed Circuit Breakers

1.03 ELECTRIC SERVICE

A. (Description the electric service installation here.)

B. Contractor shall coordinate service change with Power Company and pay all associated service charges.

PART 2 PRODUCTS

2.01 PANELBOARD AND CIRCUIT BREAKERS

A. Panelboards

1. Type: Factory assembled, dead front safety type.

2. Cabinet: Constructed in accordance with UL Standard 50 for cabinets, 20" minimum width, 14 gage minimum steel.

3. Door: Flush mounted with lock, two keys and typewritten directory. Doors shall be flush or surface type as required.

4. Gutters: Sizes of gutters shall be in accordance with UL Standard 67 for panelboards; 5" minimum on top, bottom and sides.

5. Finish: Rust inhibiting primer and gray baked enamel finish.

6. Bussing assembly: Copper bus structure and main lugs or main breaker shall have current ratings as indicated. Ratings shall be established by heat rise tests with maximum hot spot temperature on any connector or bus bar not to exceed 50°C rise above ambient and constructed in accordance with UL Standard UL 67. All bus work shall be constructed of copper.

7. Safety barriers: Main lugs, main breakers and bus structure shall be properly barriered.

B. Circuit breakers

1. Type: Bolt on, quick make and quick break type with inverse time characteristics secured through use of bimetallic tripping element supplemented by magnetic trip.

2. Interrupting capacity: Minimum RMS symmetrical amperes rated shall be:

a)	Panelboards	240V Rated	480V Rated
b)	Light & Power	10,000	14,000
c)	Distribution	22,000	22,000

3. Tripping element: Non-interchangeable, non-removable type for 225 amperes and less: interchangeable type for over 225 amperes.

4. Tripping indication: Tripping indication shall be clearly visible by operating element assuming neutral position between "on" and "off".

5. Identification: Each breaker shall be identified by individual circuit number.

6. Multipole breakers: Breakers designed so that overload in one pole automatically causes all poles to open by means of common trip.

7. Ground fault breakers: Breakers detect and interrupt ground faults by sensing imbalance between live and neutral current.

8. HACR breakers: Circuit breakers rated for use on feeding, heating, air conditioning and refrigeration equipment.

9. Branch circuit breakers feeding convenience outlets shall have instantaneous sensitive trip setting of not more than 10 times trip rating of breaker.

C. Standards: Panelboards shall be UL listed and bear UL Label.

D. Manufacturers: Square D panelboard Type as listed or equal General Electric, or Seimens ITE.

1. Distribution Panels - Type "I-Line"

2. Lighting and Power Panels - Type "NQOD"

2.02 ENCLOSED CIRCUIT BREAKERS

A. Circuit breakers with trip rating as indicated shall be suitable for use as service entrance use and shall conform to those specified for panelboards.

B. Interrupting capacity: Minimum RMS symmetrical amperes for the circuit breakers shall be as follows, unless otherwise noted on the drawings:

Circuit Breakers (Amps)	**120/208V**	**120/240V**	**227/480V**
Up to 100A	12,000	12,000	18,000
125A to 225A	18,000	18,000	25,000
250A to 400A	30,000	30,000	30,000
425A to 600A	60,000	60,000	40,000

C. Enclosures shall be NEMA 4X type equipped with rain tight hubs sized for conduit as indicated for exterior or wet areas and NEMA 1 for dry electrical rooms and inside stainless steel NEMA 4X cabinets. Enclosure shall be UL listed and equipped with padlock provisions.

D. Manufacturers: Square D "Molded Case" or equal General Electric or ITE Seimens.

2.03 DRY TYPE TRANSFORMERS

A. Construction:

1. Type: Air insulated, air cooled, conventional indoor type arranged for mounting as indicated.

2. Taps: Single phase transformers through 10 KVA will not require taps, single phase transformers 15 KVA through 25 KVA and three phase transformers 6 KVA through 15 KVA shall have two (2) 5% capacity taps below normal rated primary voltage, all transformers 30 KVA and larger shall have two (2) 2-1/2 full capacity taps above and four (4) 2-1/2% full capacity taps below normal rated primary voltage.

3. Core and coil: Manufactured from a high grade, non-aging, silicon steel with high magnetic permeability's, low hystersis and eddy current losses. Coils must be vacuum impregnated with nonhygroscopic, thermosetting varnish and have a final wrap of electrical insulation material designed to prevent injury to the magnet wire. Visible magnet wire constructed coils will not be acceptable. The core and coil unit shall be isolated from enclosure by means of vibration absorbing mounts and be supported from base frame.

4. Enclosure: Heavy gauge sheet steel, degreased, phosphatized and finished in baked enamel.

5. Insulation: Transformers rated .050 thru 2 KVA shall have insulating materials rated Class B by NEMA and be designed not to exceed an 80□C rise above a 40□C ambient with a 100% continuous load applied to the secondary. Transformers rated 3 KVA thru 15 KVA shall have Class H insulation and be designed not to exceed, 115□C rise above a 40□C ambient under the above full load conditions.

6. Sound level: Sound levels shall be guaranteed by the manufacturer not to exceed the following values:

   a) 000 to 009 KVA - 40 db

   b) 010 to 025 KVA - 42 db

   c) 026 to 050 KVA - 45 db

   d) 051 to 150 KVA - 50 db

   e) 151 to 300 KVA - 53 db

B. <u>All transformers shall have secondary surge arrestors capable of shunting high voltage spikes to ground.</u> Ratings shall not exceed 175 volts rms for single-phase three-wire systems and 605 volts rms for three phase four-wire systems.

C. Operation: Primary and transformed secondary voltages shall be as indicated.

D. Standards: Unit shall be tested in accordance with NEMA, meet ANSI Standards and be UL listed.

E. Manufacturers: Square "D" or equal Goulde-ITE, Heavy-Duty or Seimens ITE.

2.04 TRANSIENT VOLTAGE SURGE SUPPRESSION SYSTEM

A. General:

1. Transient Voltage Surge Suppression (TVSS) shall be provided to protect the 120/208-volt, 3-phase panels. The system components are to be as specified herein.

B. Each complete suppression unit shall be Underwriters Laboratories (UL) listed as a transient voltage surge suppressor per UL 1449, 1987 and if the unit contains an electromagnetic interference filter which consists of capacitors and/or inductors, the unit shall be Complementary Listed under U.L. 1283, Standard for Safety for EMI Filters.

C. Units shall bear the suppressed voltage rating issued by UL for all protected modes.

1. Systems shall be tested to meet ANSI/IEEE C62.41 1991, and as per ANSI,IEEE C62.45 1987.

2. The system shall be tested to MIL-STD 220A for electrical line noise attenuation per 50-ohm insertion loss measurement method of RF Frequencies up to 100 MHZ.

D. Materials/Construction:

1. The circuit configuration of the suppression units shall be thermal stress reducing, custom parallel, solid state.

2. Protection Modes: All modes shall be protected, i.e., Normal (L-L, L-N) and Common (N-G, L-G). Protectors for starters and VFD's shall be internally fused.

3. The suppression units shall be housed in minimum NEMA 12, 13 enclosure.

4. The design of each model shall be tested in all modes to demonstrate the capability to withstand 1,000 sequential, category B3/C1, 6kV/3kA, 8 X 20us impulses (units installed at the service entrance must be tested to withstand 1000 consequential category C3, 20kV/10kA impulses) as described in ANSI/IEEE C62.41-1991 IEEE Guide for Surge Voltages in Low-Voltage AC Power Circuits. The interval between impulses shall not exceed 30 seconds. Other aspects of the test shall be in accordance with ANSI/IEEE C62.45-1987 Guide on Surge Testing For Equipment Connected to Low Voltage AC Power. The resultant peak let-through voltage of the last impulse shall not vary from the first impulse by more than +10% or -20%. Test results shall be made available to purchaser's engineer upon request.

5. The suppression circuit shall be totally encapsulated in a thermally conductive chemical compound to enhance transient energy dissipation.

6. The TVSS shall have peak surge current of no less than 320 KA/phase (160KA, H-G) for service entrance panels, 160 KA/phase (80 KA,G) for sub-panels and 160 KA/phases for aerator starters and pump VFD's.

7. The unit shall have a sine wave tracking, parallel circuit design; series elements shall not be utilized. All circuitry shall be encapsulated in a thermally conductive chemical compound. Transient energy dissipation must not be accomplished solely by air and/or by the electronics contained in the suppression unit.

E. Manufacturer: Liebert or equal Innovative or Current.

PART 3 EXECUTION

3.01 CABLE TESTING

A. Main Secondary Feeders: Test feeders after they have been installed but prior to being energized. A Megger of 1,000 volts shall be used to perform a "Spot Reading Test" as recommended by the Biddle Instrument Co. or approved equal method. Tests shall be witnessed by Engineer and results recorded and submitted for review and approvals.

B. Primary Cable: Test cable after cable and terminators have been installed but prior to being energized. A high-voltage D.C. test shall be applied to each phase using the "Step-Voltage Method" as recommended by the Biddle Instruments Co. or approved equal method. Tests shall be performed by an independent testing agency and shall be witnessed by Engineer and results recorded, plotted on KV Megohm graph paper, and submitted for review and approval.

3.02 DRY TYPE TRANSFORMER INSTALLATION

A. Provide concrete pads or metal strut framing for installation as indicated. Provide necessary protection during construction period to insure against mechanical damage and dust accumulation. Ground as required.

B. Field tests prior to energization:

1. Megger check of phase to phase and phase to ground insulation levels.

2. Continuity.

3. Short Circuit.

C. Adjust operating mechanisms for free mechanical movement. Tighten bus connections and mechanical fasteners. Touch-up scratched or marred surfaces to match original finish.

3.03 PANELBOARD INSTALLATION

A. Install panelboard in accordance with manufacturer's recommended procedures. Provide necessary protection during construction period to insure against mechanical damage and dust accumulation.

B. Field tests prior to energization:

1. Megger check of phase to phase and phase to ground insulation level.

2. Continuity.

3. Short Circuit.

C. Adjust operating mechanisms for free mechanical movement. Tighten bus connections and mechanical fasteners. Touch-up scratched or marred surfaces to match original finish.

D. Label circuit index card with type circuit identification.

3.04 ELECTRIC SERVICE INSTALLATION

A. Install new underground feeders, primary and secondary service equipment and all associated work for a new service and distribution arrangement as indicated and as per power co.’s specifications

B. Contractor shall coordinate with the Power Company installation of the new required service.

END OF SECTION

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SECTION 16410

STAND-BY POWER GENERATION

PART 1 GENERAL

1.01 DESCRIPTION

A. Perform all work necessary and/or required and furnish all materials and equipment for a complete installation of the stand-by generator(s). Such work includes, but is not limited to, the following:

1. Installation of generator with associated concrete foundation. (for exterior location)

2. Installation of generator with associated ducting to outside louver, vent piping, fuel fill piping and controls. (for interior location)

3. Provide Automatic transfer switch with specified controls.

B. Consult Section 16050 for work, materials, and methods specified in that Section.

1.02 VENDOR

A. One vendor shall supply both the generator and automatic transfer switch as a “Stand-by Power System”.

B. Vendor shall also maintain the generator and automatic transfer switch as a “Stand-by Power System” so the owner has a single point contact for maintenance.

1.03 SUBMITTALS

A. Specifications and drawings: The bidders shall furnish information showing manufacturers' model numbers, dimensions and weights for the generator set and major auxiliary equipment. Proposed deviations from the specifications shall be stated in the bid. The successful bidder shall submit copies of pertinent drawings and wiring diagrams for approval.

B. Furnish Shop Drawings and descriptive data, complete with project designation, for the following:

1. Stand-By Generator

2. Exterior Enclosure (when specified)

3. Automatic Transfer Switch

4. Battery Charger

1.04 STAND-BY POWER SYSTEM WARRANTY

A. The complete STAND-BY POWER SYSTEM, including but not limited to Stand-by Generator, Automatic Transfer Switch, Battery Charger and all related accessories, shall be warranted against defects for 5 years parts and labor.

PART 2 PRODUCTS

2.01 STAND-BY GENERATOR

A. General

1. Materials and workmanship: All materials, equipment and parts comprising the units specified herein, shall be new and unused, of current manufacture and of highest grade. This specification shall apply to both generator sets.

2. Manufacturer: The engine, generator, and all major items of auxiliary equipment shall be manufactured in the U.S. by manufacturers currently engaged in the production of such equipment. The unit shall be factory assembled and tested by the engine manufacturer and shipped to the job site by his authorized dealer having a parts and service facility within a 50 mile radius.

3. The generator set shall be as manufactured by Onan, Kohler, MTU or approved equal.

4. Warranty: Equipment furnished under this section shall be guaranteed against defective parts or workmanship under terms of the manufacturer's one-year standard warranty.

5. Tests: The generator set shall receive the manufacturer's standard factory load testing.

B. Generator set characteristics

1. Acceptable units:

a. Under 100 KW

Onan, Kohler, MTU with sound enclosures or approved equal.

b. Over 100 KW

Quiet Site II series by Cummins or Onan, Kohler, MTU with sound enclosures

2. Rating @ 1800 RP

a.	Standby KW w/ fan	See drawings.
b.	Standby KVA w/ fan	See drawings.

c. Frequency 60 Hz

d. The specified standby KW shall be for continuous electric service during interruption of the normal utility source.

4. Voltage: See drawings for generator output voltage.

C. Engine

1. Type: The engine shall be water-cooled in line or Vee type four stroke cycle compression ignition diesel. It shall meet specifications when operating on No. 2 diesel oil. Diesel engines requiring premium fuels will not be considered. The engine shall be equipped with fuel, lube oil and intake air filters; lube oil coolers, fuel transfer pump, fuel priming pump and gear driven water pump.

a. Governor: Isochronous type to maintain constant steady state engine speed from no load to full load, and + 0.25% frequency variation at constant load, including no load.

2. Mounting: The unit shall be mounted on a structural steel sub base and shall be mounted on with suitable spring vibration isolators.

3. Safety Devices: Safety shut offs for high water temperature, low oil pressure, overspeed and engine overcrank shall be provided.

4. Instrument panel: Instrument panel includes engine oil pressure, and water temperature gages, D.C. voltmeter.

D. Generator

1. Type: The generator shall be a three phase, 60 Hz single bearing, synchronous type with brushless exciter and be built to NEMA Standards. Class F insulation shall be used on the stator and rotor, and both shall be further protected with 100% epoxy impregnation and an overcoat of resilient insulating material to reduce possible fungus and/or abrasion deterioration. Generator shall incorporate reactive droop compensation.

2. Regulator: A generator-mounted volts per Hertz type regulator shall be provided to match the characteristics of the generator and engine. Voltage regulation shall be + 2% from no load to full rated load. Readily accessible voltage droop, voltage level and voltage gain controls shall be provided. Voltage level adjustment shall be a minimum of + 5%. The solid-state regulator module shall be shock mounted and epoxy encapsulated for protection against vibration and atmospheric deterioration.

E. Cooling System

1. Radiator: A skid-mounted radiator cooling system with blower type fan shall be sized to maintain safe operation under full load at 104 degrees F. maximum ambient temperature as measured at the generator air inlet. The radiator shall

be equipped for a duct adapter flange. Airflow restriction from the radiator shall not exceed 0.5" H2O. Contractor shall provide ductwork with flexible connecting section between radiator duct flange and exhaust damper.

2. Antifreeze: The engine cooling system shall be filled with a solution of 50%/50% ethylene glycol and water mixture.

F. Fuel System

1. Generator shall have a sub-base dual wall fuel tank factory installed within the generator skid with engine supply and return lines pre-plumbed. Fuel tank shall be constructed of aluminized steel, welded construction, pressure tested to psi, equipped with low and high level alarm contact and indicating light and have a integral fuel pump and motor related 120 volts AC.

2. Fuel tank shall be sized for 24 hours of generator operation @ ¾ load.

G. Exhaust System

1. Exhaust shall be critical grade.

H. Automatic Starting System

1. Starting motor: A 24-volt DC electric starting system with positive engagement drive shall be furnished.

2. Automatic controls: Fully automatic generator set start/stop controls in the generator control panel shall be provided. Controls shall provide shut down for low oil pressure, high water temperature, overspeed, overcrank and one auxiliary contact for activating accessory items. Controls shall include a 30 second single cranking cycle limit without lockout.

3. Jacket water heater: A unit mounted thermostat controlled jacket water heater shall be furnished to maintain engine jacket water to 90 degrees F. in an ambient temperature of 30 degrees F. The heater shall be sized as per manufacturer's recommendation. Heater shall be Chromalox or equal.

4. Batteries: A 24-volt lead acid storage battery set of the heavy-duty diesel starting type shall be provided. The battery set shall be of sufficient capacity to provide for one and one half minutes total cranking time without recharging and will be rated no less than 220 amp hours. A battery rack and necessary cables and clamps shall be provided.

5. Battery charger: A current limiting battery charger shall be furnished to automatically recharge batteries. Charger shall float at 2.17 volts per cell and equalize at 2.33 volts per cell. It shall include overload protection, silicon diode full wave rectifiers, voltage surge suppressors, D.C. voltmeter, D.C. ammeter and fused A.C. input. A.C. input voltages shall be the 120 volts. Amperage output shall be no less than 6 amperes. It shall have the following options:

a) A.C. power failure relay

b) Low D.C. voltage alarm relay

c) Manufacturer: LaMarche model A 46 24 6 or approved equal

I. Generator control panel

1. Type: A generator mounted NEMA 1 type vibration isolated dead front 14-gage steel control panel shall be provided.

2. Equipment: Panel shall contain, but not be limited to, the following equipment:

a. Automatic starting controls as specified in H.2

b. Voltmeter, 2% accuracy

c. Ammeter, 2% accuracy

d. Ammeter phase selector switch

e. Frequency meter, dial type

f. Panel illumination lights and switch

g. Voltage level adjustment rheostat

h. Dry contacts for remote alarms wired to terminal strips

i. Fault indicators for low oil pressure, low and high coolant temperature, low coolant level, overspeed, overcrank, and low fuel level.

j. Four position, function switch marked "auto", "manual", "off/reset", and "stop"

k, Running time meter

3. Control panel shall be mounted facing the side or rear.

B. Main line circuit breaker

1. Type: A generator mounted main line molded case circuit breaker shall be installed as a load circuit interrupting and protection device. It shall operate both manually for normal switching function and automatically during overload and short circuit conditions.

2. The trip unit for each pole shall have elements providing inverse time delay during overload conditions and instantaneous magnetic tripping for short circuit protection. The circuit breaker shall meet standards established by Underwriters' Laboratories, National Electrical Manufacturer's Association, and National Electrical Code.

3. Generator exciter field circuit breakers do not meet the above electrical standards and are unacceptable for line protection.

C. Outdoor Weather-Protective Sound Attenuating Housing (if outside)

1. Provide a factory-installed sound-attenuated housing which allows the generator set to operate at full rated load in the ambient conditions previously specified.

2. The enclosure shall reduce the sound level of the generator set while operating at full rated load to a maximum of 63-70 dBA at any location 7 meters from the generator set in a free field environment. Housing configuration and materials used may be of any suitable design which meets application needs, except that acoustical materials used shall be oil and water resistant. No foam materials shall be used unless they can be demonstrated to have the same durability and life as fiberglass.

3. The enclosure shall include hinged doors for access to both sides of the engine and alternator, and the control equipment. Key-locking and padlockable door latches shall be provided for all doors. Door hinges shall be stainless steel.

4. The enclosure shall be provided with an exhaust silencer, which is mounted inside of the enclosure, and allows the generator set package to meet specified sound level requirements. Silencer and exhaust shall include a rain cap and rain shield.

5. All sheet metal shall be primed for corrosion protection and finish painted with the manufacturers standard color using a twostep electrocoating paint process, or equal meeting the performance requirements specified below. All surfaces of all metal parts shall be primed and painted. The painting process shall result in a coating which meets the following requirements:

   a. Primer thickness, 0.5-2.0 mils. Top coat thickness, 0.8-1.2 mils.

   b. Gloss, per ASTM D523-89, 80% plus or minus 5%. Gloss retention after one year shall exceed 50%.

   c. Crosshatch adhesion, per ASTM D3359-93, 4B-5B.

   d. Impact resistance, per ASTM D2794-93, 120-160 inch-pounds.

   e. Salt Spray, per ASTM B117-90, 1000+ hours.

   f. Humidity, per ASTM D2247-92, 1000+ hours.

   g. Water Soak, per ASTM D2247-92, 1000+ hours.

6. Painting of hoses, clamps, wiring harnesses, and other non-metallic service parts shall not be acceptable. Fasteners used shall be corrosion resistant, and designed to minimize marring of the painted surface when removed for normal installation or service work.

1.05 AUTOMATIC TRANSFER SWITCH

A. General

1. Switch shall be a 60 Hz operating device at an ampere rating and voltage characteristics as indicated on the drawings complete with accessories as herein specified.

2. The automatic transfer switch shall be mechanically held and electrically operated by a single solenoid mechanism energized from the source to which the load is to be transferred. The switch shall be rated for continuous duty and be inherently double throw. The switch shall be mechanically interlocked to ensure only one of two possible positions normal or emergency. Switches utilizing linear motors to initiate transfer are not acceptable.

3. All main contacts shall be the silver alloy wiping action type. The operating transfer time in either direction shall not exceed one sixth (1/6) of a second.

4. All replaceable contacts, coils, springs, and control elements shall be conveniently removable from the front of the transfer switch without major disassembly or disconnection of power conductors. Sensing and control relays shall be continuous duty industrial control grade type with a minimum contact rating of ten amperes.

5. The automatic transfer switch shall include a separately mounted control panel with adjustable solid state sensing and timing functions. The control module shall direct the operation of the transfer switch. The module's sensing and logic shall be controlled by a built in microprocessor for maximum reliability, minimum maintenance, and with inherent digital serial communications capability. The control module shall be connected to the transfer switch by an interconnection wiring harness. The harness shall include a keyed disconnect plug to enable the control module to be disconnected from the transfer switch for routine maintenance.

6. The automatic transfer switch shall conform to the requirements of NEMA Standard ICS 2 447 and Underwriters' Laboratories UL 1008 and shall be UL listed as follows:

   a. For use in standby systems in accordance with Article 702 or the National Electrical Code.

   b. Rated in amperes for total system transfer including control of motors, electric discharge lamps, electric heating and tungsten filament lamp loads as referred to in Paragraph 30.9 of UL 1008.

   c. Transfer switches shall be suitable for 100 percent tungsten filament lamp load.

B. Operation:

The following settings shall be field adjustable with no special tools required.

1. Undervoltage sensing of all normal source phases.
   a. Pickup voltage 85 98% of nominal voltage
   b. Dropout voltage 75 98% of pick up setting.
   c. Dropout Time Delay: 0.1 to 1.0 sec.
2. Overvoltage sensing of all normal source phases.
   a. Dropout: 105% to 135% of nominal voltage
   b. Dropout voltage 75 98% of pick up setting.
   c. Dropout Time Delay: 0.5 to 200 sec.
3. Voltage Imbalance Sensing
   a. Dropout: 2% to 10%
   b. Pickup: 90% of dropout
   c. Time Delay: 100msec.
4. Frequency Sensing
   a. Pickup: ±5% to ±20% of nominal frequency
   b. Dropout: ±1% beyond pickup
   c. Dropout Time Delay: 0.1 to 15 sec.
5. Phase Rotation Sensing: Time delay 100 msec.
6. Time Delays
   a. Engine Start Delay: 0 – 120 seconds
   b. Transfer Normal To Emergency: 0 – 120 seconds
   c. Retransfer Emergency to Normal: 0 – 30 mins.
   d. Engine Cool Down: 0 – 30 mins.
   e. Programmed Transition: 0 – 60 secs

C. Standard features and controls shall include the following:

1. Test switch simulates failure of normal source (momentary type).
2. Gold plated engine-starting contacts (10 ampere SPDT).

3. One set of auxiliary contacts rated at 10 amps, 480VAC. One contact closed when ATS is connected to normal and one contact closed when ATS is connected to generator.

4. Pilot lights indicate switch position.

5. The exercising timer shall be built in to the ATS module and shall include a selector switch to select exercise with or without load transfer. The exerciser shall be solid state for maximum reliability and minimum maintenance and shall be programmable to enable exercise for 1 minute to 24 hours per day (in one minute increments) for 0 to 7 days per week. Exercise setting shall be set by pushbutton and a digital display shall be provided to indicate settings. A Replaceable, built in battery shall be provided to enable the exerciser to continue to operate for up to two weeks without external power. A built in battery charger shall extend battery life to at least five years. Loss of the battery shall not disable the exercise function as long as normal power Is present.

D. Accessories shall include the following:

1. Toggle switch manually bypasses time delay on retransfer.

2. Auxiliary contacts 1 N/C and 1 N/O on "Normal" (10 amps, 480 VAC.)

3. Micro processor: Output terminals shall be provided to signal the actual availability of the normal and emergency sources, as determined by the voltage sensing pickup and dropout settings for each source.

4. Enclosure

a. Transfer switch shall be provided in a gasketed NEMA 12 gasket enclosure.

E. Manufacturer

1. Automatic Transfer Switch shall be as manufactured by Cummins Model OTPC Power Command (heavy duty type) with Level 2 Control, ASCO, Russelectric Company or approved equal.

PART 3 EXECUTION

3.01 STAND-BY GENERATOR INSTALLATION

A. Install emergency generator system package complete with all accessories and make all connections as required. Provide wiring as required to battery charger, transfer switch and jacket heater.

B. On completion of the installation, contractor shall have the generator supplier perform system start up and exercise installation through an automatic start up on loss of normal power, operation under load and retransfer to normal power upon re energization of

normal service. Generator supplier shall provide a certificate certifying proper operation of installation.

C. Prior to acceptance of the installation, equipment shall be tested to show it is free of any defects and will start automatically and be subjected to full load test, using that load which is available at the job site and a load bank. The test shall continue for four (4) hours, and any defects shall be corrected at no additional cost to the Owner.

3.02 AUTOMATIC TRANSFER SWITCH

A. Install ATS complete with all accessories and make all connections as required.

B. On completion of the installation, contractor shall have the generator supplier perform system start up as described above in 3.01 paragraph B.

C. Start up and instructions: Operating and maintenance instruction books shall be supplied upon installation of the unit and procedures explained to operating personnel.

D. Prior to acceptance of the installation, equipment shall be tested to show it is free of any defects. All functions specified will be demonstrated for proper operation.

END OF SECTION

SECTION 16500

ELECTRICAL LIGHTING

PART 1 GENERAL

1.01 NOTICE

A. Perform all work necessary and/or required and furnish all materials and equipment for construction of a complete system of indoor and outdoor building lighting.

B. Consult Section 16050 for related work, materials and methods specified in that Section.

1.02 SUBMITTALS

A. Furnish Shop Drawings and descriptive data, complete with project designation for lighting fixtures.

B. Shop Drawings shall be in accordance with General Conditions and Supplementary Conditions of these Specifications.

PART 2 PRODUCTS

2.01 LIGHTING FIXTURES

A. Provide lighting fixtures and lighting equipment as indicated and listed in "Lighting Fixtures Schedule".

1. Connect fixtures and equipment to building electric wiring.

2. Provide materials and accessories, whether or not specifically described of best grade of industrial manufacture.

C. Provide manufacturer's standard finish on fixtures except as otherwise noted. "Color by Owner" denotes that Owner shall select color during shop drawings phase.

D. Reflecting surface of metal bowls and shades finished synthetic white baked at 250°F or higher, except as otherwise noted.

1. Use of word "Acrylic" in lighting fixture description means 100% virgin acrylic plastic.

E. Fasten exterior fixtures with brass and brackets.

1. Provide outdoor lighting fixtures with poles, concrete bases (3000 psi), anchor bolts, bolts, etc., required for proper installation.

F. All fixtures bear UL label.

2.04 LAMPS

A. The Contractor shall provide lamps for all fixtures.

1. Fluorescent lamps: Lite White energy savings type (34 Watt) - except as indicated otherwise. Compact fluorescent lamps shall have color temperature specified.

2. Metal Halide Lamps: Clear I-line - G.E. Watt-Miser type where available.

3. Sodium vapor: Superior performer clear bulb type where available.

B. All fixtures shall have lamps in proper working order at time of final acceptance of building by Owner.

2.05 FLUORESCENT LIGHTING

A. Lampholders: Designed so that lamps may be inserted or removed easily, but hold lamps firmly in place.

B. Ballasts:

1. Type: Rapid-start, high power factor (over 90%) with sound rating "A", energy saving type.

2. Operation: Ballasts operate two lamps in series at not less than 92-1/2% or rated wattage or more than 120% rated current when operating at rated line voltage 2500-volts to ground test.

3. Overload protection: Non-resetting thermal protectors; fuses not acceptable.

4. Ambient conditions: Contractor responsible for proper ballasts to meet ambient conditions.

5. Standards: Conform for CBM/ETL Standards.

6. Noise level: Noise level of ballasts shall not exceed acceptable level for very quiet location.

PART 3 EXECUTION

3.01 LIGHTING FIXTURE INSTALLATION

A. Supporting lighting fixtures from structure:

1. Do not depend on ceiling or roof deck for support.

2. All surface and stem suspension fixtures shall be anchored to the ceiling in a secure manner.

3. All suspended fluorescent fixtures shall be equipped with earthquake-proof type hangers with universal joints type hanger canopy and a lateral sway adapter in each supporting stem.

4. Provide suitable support independent of outlet boxes as required.

5. Supports or fixtures other than by outlet box shall be preset concrete inserts, or caulking anchors as required.

6. Fluorescent fixtures 48" or longer shall be supported with a suitable fixture stud in each outlet box.

7. All surface mounting fixtures more than 18" wide, in addition to the support from the outlet box, shall be supported at, or near, each corner.

8. Fixtures weighing more than 50 pounds shall be supported independently of the outlet box.

9. All recessed fixtures shall be installed using supporting brackets, grounds, plastic rings, etc., as recommended by the manufacturer.

10. All supports for fixtures shall be furnished.

B. Provide suitable frame for all fixtures requiring same. See Architect's drawings for ceiling types.

C. Polarize each fixture.

D. Fixtures shall be wired in strict accordance with latest requirements of NFPA.

1. Protect wiring with tape or tubing at all points where abrasion is liable to occur.

2. Conceal all wiring within fixture construction.

3. Do not locate splice or tap within arm or stem.

4. Install wire continuous from splice in outlet box on building wiring system to lampholder or to ballast and from ballast to lampholder.

5. Solder and insulate with plastic tape all joints in fixture wiring.

6. Approved solderless connects may be used in making connections in wiring within fixture or in connecting fixture wire to wiring of building.

7. No exposed wiring permitted on outdoor fixtures; conceal wiring in bases, poles or fixtures.

E. Lighting layouts indicated are generally diagrammatic and location of outlets and equipment is approximate; exact location of fixtures shall be determined in the field.

END OF SECTION

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SECTION 16900

ELECTRICAL CONTROLS AND INSTRUMENTATION

PART 1 GENERAL

1.01 SCOPE

A. Perform all work necessary and/or required and furnish all materials and equipment for complete system of electrical controls for the building. Such work includes, but is not limited to, the following:

1. Motor starters, controllers, relays, wiring and connections.
2. Mechanical equipment wiring.
3. Motor Control Center

B. Consult Section 16050 for work, materials, and methods specified in that Section.

1.02 SHOP DRAWINGS

A. Furnish shop drawings and descriptive data, complete with project designation, for the following:

1. Motor starters and controllers.
2. Relays and contactors.
3. Indicating Devices and Control Operators.
4. Auto Dialer
5. Level Sensors/Controllers for Chemical Feed Tank.
6. Level Sensors – Pressure Transducers.

PART 2 PRODUCTS

1.01 MOTOR CONTROL CENTER

A. General:

1. The motor control center shall be of the totally enclosed, dead front, free standing assembly and shall be of supplier's standard design. The enclosures shall be gasketed NEMA 12.
2. Wiring shall be NEMA Class I, Type B. Motor starters shall be circuit breaker type combination units. All equipment and wiring shall conform to or exceed the rules and regulations of the latest published standards of NEMA Publication ICS2.322 and UL 845 for Motor Control Centers.

3. Power supply shall be 277/480 volts, 4 wire, 3 phase, 60 Hertz. The Control voltage shall be 120 volts and source shall be by individual control transformers.

B. Structure:

1. Enclosure: Vertical free standing, sections each 20" wide, with minimum 3" wide vertical wireway, "15" or "20" deep as required and 90" high with heavy gauge steel in compliance with UL 845.

2. Grouped Assemblies: Assemblies consisting of two or more sections shall be suitable for individual section shipping. Assemblies shall be designed to permit future additions.

3. Wireways: Horizontal wireways required on both top and bottom, vertical wireway required full height in each vertical section. Wireways shall be completely isolated from all busses.

4. Finish: Prime with rust inhibiting primer and finish in #49 medium gray baked enamel per ANSI Standard Z55.1-1967.

C. Bus System:

1. Construction: Bus shall be copper and electrolytically tin plated type using ALSTAN 70 process. Horizontal bus shall be continuous for full length of shipping sections. Connections between horizontal and vertical bus shall be made with bolts and conical spring washers for constant pressure. Bus connections to be completely serviceable from front.

2. Bus Rating at:

a) Size and rating as noted on the drawings.

b) Horizontal and vertical bus shall be braced for 42,000 rms symmetrical amperes.

3. Bus Barriers: Horizontal bus shall be housed in a molded gas filled polyester insulating support assembly isolated from top horizontal wireway by a grounded steel barrier. Vertical bus shall be housed in modular gas filled polyester supports to provide insulation and bracing. These barriers shall be red in color. Vertical bus barriers to have removable cover type stab-on opening to permit unit plug-in contacts to engage the vertical bus bar.

4. Each motor control center to have a horizontal 600A ground bus located in the bottom horizontal wireway.

D. Control Units:

1. Unit plug-in features:

a) Unit plug-in type with floatable, self-aligning, tin plated, spring tempered copper fingers designed to increase contact pressure under load or short-circuit conditions. Plug-on units shall utilize the two stage "ADVANCE/RETRACT" operating mechanism.

b) Unit plug-in compartments shall be available for starters up to NEMA Size 4 combination type or molded case circuit breakers through 250A or fusible switch through 200A.

c) Unit plug-on compartments shall be supported by a removable assembly to allow for unit rearrangement to be accomplished easily.

d) All unit plug-on compartments shall be isolated from one another.

2. Disconnect Devices:

a) The operator handle of the compartment doors shall be mechanically interlocked so that the door cannot be opened with the disconnect device in the "ON" position. However, this interlock shall be equipped with a "defeater" for authorized personnel to gain access to the compartment without turning disconnect device off. Provision for padlocking each handle shall also be furnished. The operator shall be color coded to display on and off position.

b) Disconnect devices shall be motor circuit protector type (HMCP) for all starter units.

3. General for All Starter Units:

a) Indicating devices (cover mounted):

1) Pilot lights: Transformer style, push-to-test type; amber for high speed, green for single and low speed, and red for overload alarm light and current monitor shutdown indication light.

2) Elapsed time meter; non-resettable, six digit.

b) Control operators: Start-stop (momentary), ON/OFF and Hand-Off automatic selector switches as indicated and as specified.

c) Ammeter: Provide ammeter complete with current transformer for single leg monitoring for the starters as indicated on plans. Range of ammeter scale shall be selected which shows accurate indication of current flow to the motor being monitored.

d) Wiring: Minimum control wiring shall be #16 AWG 90 C Type MTW, VW-1 rated copper conductors, 600V insulation (NEMA Class 1).

Minimum power wiring shall be #10 AWG, 90 C, VW-1 rated copper conductors.

4. Magnetic Starter Units:

   a) Type: Magnetic, across-the-line, combination circuit breaker, full voltage, non-reversing as indicated.

   b) Overload relays: Melting alloy or bimetallic type with overload alarm circuit contact.

   c) Contacts: Double break silver alloy contacts for NEMA size six and larger; provide minimum of two sets of auxiliary contacts in addition to holding circuit contact.

   d) Coils: Hot molded construction protected from overheating and equipped with surge suppressors.

   e) Control voltage: 120 volts; provide integral control transformers as required with fused protection on both primary and secondary legs and one leg of secondary grounded. Transformer capacity shall be minimum of 40 VA larger than required for starter control.

5. Solid State Starter Units

   a) Description: Solid State Motor Controller provides microcomputer-controlled starting for standard squirrel cage induction motors. Controller shall be 360 amp rated at 460 volts 60 Hz and mounted in the motor center with motor circuit protector type disconnect device.

   b) The controller shall have Energy Saver feature for applications where the motor is lightly loaded or unloaded for long periods of time. Controller shall be complete with fast-acting SCR fuses, current transformer type overload module with auxiliary alarm contacts and factory wired with control devices, indicators, etc. and indicated on control wiring diagram.

   c) Mode of Operation:

      1) Soft Start with pump control option provides smooth acceleration on starting of 2 to 30 seconds and deceleration on stopping of 2 to 120 seconds to reduce effects of surges by starting and stopping of centrifugal pumps.

   d) Self-Calibrating: The microcomputer based control shall be self-calibrating for:

      1) Any line voltage level and frequency within its rating, and

2) Any current value at or below the continuous rating of the controller.

e) Protective Module containing metal oxide varistors (MOV's) and capacitors shall be installed to protect the power components from electrical transients and/or high electrical noise. The protective modules clip transients generated on the lines and prevent such surges from damaging the SCR's.

f) Manufacturer: Allen-Bradley Bulletin 150 Smart Motor Controller or equal.

6. Adjustable Frequency Drives:

a) Type: Microprocessor based, high performance, 3 phase, variable torque adjustable frequency AC drive to be mounted in the motor control center as indicated. Provide with motor circuit protector disconnecting device. Provide with pushbutton control and display panel.

b) Input Power: Voltage 380-460V AC ±, frequency 48 to 62 Hz, 3 phase.

c) Trips: Input over voltage, input under voltage, bus overvoltage, bus undervoltage, line transient protection, drive output overcurrent trip and ground fault.

d) Output waveform: Sine coded pulse width modulated waveform.

e) Output Voltage: 0 to applied input voltage.

f) Frequency Range: 0 to 250 Hz with programmable minimum and maximum limits. Analog frequency resolution.

g) Two independently programmable accel and decel times with programmable range 0 to 600 seconds.

h) Options:

1) Auxiliary alarm contacts, two form C contacts.

2) 4-20 ma analog output

3) Isolated signal conditioner, isolated user signal from drive logic common and ground.

4) Input circuit breaker

5) Manual bypass, drive/off/bypass selector switch

i) Manufacturer: Allen Bradley 1336VT with options PAA, PG4, PN1, 3CB-250CB, 3BM-250BM or approved equal.

E. Branch feeder units:

1. Thermal magnetic circuit breaker assemblies.

F. Identification:

1. Control unit , feeder breaker, and credit identification with bakelite nameplates, credit (3" x 6"), control unit (2-1/2" x 3/4") black background with engraved white lettering.

G. Manufacturers:

1. Square D Class 8998, Model 6 or equal Allen-Bradley Bulletin 2100 Centerline or approved equal.

2.02 MAGNETIC MOTOR STARTERS

A. Construction:

1. Type: Across-the-line magnetic type.

2. Overload relays: Melting alloy or bimetallic type with overload alarm circuit contact.

3. Contacts: Double break silver alloy contacts for NEMA size six and larger; provide minimum of one set of auxiliary contacts in addition to holding circuit contact.

4. Coils: Molded construction for NEMA size five and smaller; form wound, taped, varnished and baked for NEMA size six and larger.

5. Control Voltage: 120 volts; provide integral control transformers as required with fused secondary protection in one leg and other leg grounded. Transformer capacity shall be a minimum of 40 VA larger than required for starter control.

6. Indicating devices (cover mounted):

a) Pilot lights: Transformer style, push-to-test type, amber for high speed, green for single or low speed and red for overload alarm indication.

7. Control operators: START-STOP (momentary), ON-OFF and Hand-Off-Automatic switches as indicated and as specified. Provide remote pushbutton stations with lockout devices. Enclosed motor starters shall have a Hand-Off-Automatic switch.

8. Circuit Breaker: Combination starter where indicated, circuit breaker designed for motor circuit protection in accordance with the NEC.

9. Identification: Engraved nameplates shall be provided for each starter as specified herein.

10. Enclosures: NEMA I Indoors.

11. Provide one set of normally NEMA Standards.

B. Standards: Equipment shall conform to latest NEMA Standards.

C. Manufacturers: Square "D" Class 8536, Class 8538 or 8539 for combination type; or equal Allen-Bradley or Gould-ITE.

2.03 MANUAL MOTOR STARTERS

A. Construction:

1. Type: Quick make and break toggle operated two or three pole switch type.

2. Overload relay: Melting alloy or bimetallic type; provide starters with and without overloads as indicated.

3. Contacts: Double break silver alloy contacts.

4. Rating: 1 HP maximum, 230 volts maximum.

5. Terminals: Binder head screw type.

6. Pilot lights: Neon pilot light with red lens.

7. Enclosures: NEMA I Indoors, NEMA 4 Outdoors.

8. Identification: Identify motor starter with black plastic adhesive tape with raised white letters.

B. Standards: Equipment shall conform to latest NEMA Standards.

C. Manufacturer: Square "D" Class 2510 or equal General Electric or Gould-ITE.

2.04 RELAYS AND CONTACTORS

A. Relays:

1. Type: Electro-magnetically operated and held type, single or multiple pole as indicated.

2. Contacts: Silvered alloy, double break, convertible type.

3. Rating: 10 amperes non-inductive load.

4. Accessories: Mechanical latch and pneumatic timer attachments as indicated.

5. Enclosure: NEMA I Indoors, NEMA 4 Outdoors.

6. Manufacturer: Square "D" Class 8500, Type X or equal General Electric or Gould-ITE.

B. Contactor (Lighting):

1. Type: Multiple, electrically operated, mechanically held with coil clearing contacts.

2. Manufacturer: Square “D” Class 8903 or equal General Electric or Gould-ITE.

C. Contactor (Miscellaneous Power):

1. Type: Electrically operated, mechanically held with coil clearing contacts.

2. Manufacturers: Square “D” Class 8508, or equal General Electric or Gould-ITE.

2.05 INDICATING DEVICES AND CONTROL OPERATORS

A. General: All devices shall be heavy duty, oil-tight, dust tight and mounted on control panel or in NEMA 12 enclosure. Provide individual engraved nameplates or every device as indicated.

B. Indicating Devices:

1. Elapsed time meters with six digits, 120V, non-resettable shall be provided on motor starter contactor enclosure, or for surface mounting as indicated.

2. Pilot lights shall be transformer type with push test feature. Colored lenses shall be provided in the color indicated.

3. LCD indicator with 0.5" high LCD-3-1/2" digit with minus sign (-1999 to 1999) selectable decimal point or right-hand dimming zero operated at 5 VC at 2 mA in NEMA-4/IP65 rated enclosures with diecast bezel and high impact plastic lens.

4. Bargraph: Analog solid state high-resolution display with red high intensity LEDs. The bar graph shall have segmented LED display, 50 segments, 2% resolution, 0.5% accuracy, NEMA 4 drip proof bezel and 4 to 20 mA input. Bowmar #APM 600 or approved equal.

C. Control Operators:

1. All operators shall be suitable for mounting in a 1-7/32 inch diameter hole.

2. Pushbuttons and selector switch shall have interchangeable colored caps.

D. Contact Blocks:

1. All contact blocks shall be S.P.D.T. suitable for mounting side by side and/or tandem to the operator.

2. Terminals shall be pressure wire type with self-lifting pressure clamp that will accept wire sizes #12-#18.

3. Contacts shall be silver plated and double break.

E. Manufacturers: Square "D" Class 9001, Type "X" or equal Allen Bradley or General Electric.

2.06 AUTO DIALER

A. An automatic telephone dialer unit shall be provided which will automatically call predetermined telephone numbers when any alarm condition is indicated at the alarm annunciator panel. The unit shall transmit a programmed message stating nature of the alarm conditions. If the called number is busy, does not answer or if an incorrect number is reached, the unit shall hang up and call up to four back-up numbers. Once the call is received, the person receiving it can acknowledge the unit from his telephone so that it will hang up and not place any more calls.

B. The unit shall monitor up to sixteen (16) sets of alarm contacts, which can activate telephone numbers and voice messages. Channel shall have built in AC monitoring circuitry so that if the AC power is lost to the station, the unit will automatically call out. There shall be a bypass switch so that this function can by bypassed and Channel used for other external alarms.

C. The unit shall have an adjustable (0-90 seconds) time delay to allow time for the operator to respond to the alarm. Also, a rechargeable battery unit shall be included to notify of AC power loss. The battery shall have sufficient capacity to supply six hours of calling after AC power failure.

D. Dialing Format

1. Standard rotary pulse. FCC registered. Dials up to 8 different numbers.

E. Alarm Acknowledge

1. Done by pressing a Touch Tone "9" during alarm call, or by calling dialer back after alarm call is completed.

F. Acknowledged Alarm Conditions

1. Upon acknowledging any alarm condition by touch tone or by callback (call-in following an alarm call-out), a timeout period (called "Alarm Reset Time") begins counting down. If the input condition for that channel has not returned to normal before this timeout, the alarm will be reactivated and the dialer will begin placing alarm calls again. This "Alarm Reset Time" is normally one hour. However, the user may program any other "Alarm Reset Time" on the keyboard up to 99 hours, or he may program "No Alarm Reset". The same "Alarm Reset Time" is common to all channels and also to Power Failure Alarm.

G. The unit shall be factory wired and tested and to be enclosed in a NEMA 4X enclosure. The unit shall be a Raco Verbatim or equal.

2.07 LEVEL MONITORING SYSTEM: CHEMICAL FEED TANK

A. Level sensing system shall consist of PVC coated electrodes submersed in applicable material. Electrodes shall be connected to induction relays.

B. Weatherproof and corrosion proof holder for support of electrodes shall be either B/W "6012-KF2" series or "3012-FR56" series. Coordinate holder type with tank manufacturer to allow tank cover to be removable.

C. Sodium Hypochlorate: Induction Relay: 120V primary coil voltage, 24V secondary coil voltage. Contact arrangement field changeable. Use normally open. Contact rated 25A @ 120V. Automatic reset. NEMA 4X Enclosure. As manufactured by B/W Controls, Induction Relay "1500 Series".

D. Ferric Chloride: Solid state adjustable sensing circuit relay, 120V, DPDT load contacts, NEMA 4X Enclosure as manufactured by B/W Controls #5200L.

E. Alum: Solid state adjustable sensing circuit relay, 120V, DPDT load contacts, NEMA 4X Enclosure as manufactured by B/W Controls #5200L.

F. Level sensing electrodes shall be PVC coated and of the following material:

1. Sodium Hypochlorate: Hastelloy C

2. Ferric Chloride: Hastelloy C with carbon tips

3. Alum: as recommended from manufacturer.

G. All materials shall be rated for direct contact with the chemical to be used for.

2.08 CABINETS: 2 DOOR FREE STANDING

A. Cabinet shall be a two door enclosure which meets or exceeds the requirements of a NEMA 12 rating, be U.L. listed, and suitable for wall mounting.

B. Construction:

1. General:

a) The cabinet and doors shall be constructed of type 304 stainless steel with 14-gauge minimum thickness. External welds shall be made by using the Heliarc welding method; whereas, internal welds will be made by the wire welding method. All welds shall be nearly formed and free of cracks, blow holes and other irregularities.

b) All inside and outside edges of the cabinet shall be free of burrs.

c) The door opening shall be double flanged on all (4) sides which increases strength around openings and keeps dirt and liquids from entering the enclosure when door is opened.

C. Door/Hardware:

1. The door opening will be a minimum of 80% of the front surface area. Double door will overlap and utilize a removable center post.

a) The doors shall be furnished with a gasket that satisfied the physical properties as found in UL508 table 21.1 and shall form a dust-tight seal between the cabinet and door.

b) The closed doors will be flush with the sides of the enclosure.

2. The hinges shall be continuous and bolted to the cabinet and door utilizing 1/4-20 stainless steel carriage bolts and nylock nuts.

a) The hinges will be made of .093 inch thick aluminum and shall have a .250 inch diameter stainless steel hinge pin.

b) The hinge pin shall be capped top and bottom by weld to render it tamperproof.

c) Hinge leaves will not be exposed externally when the door is closed, but hinge knuckles may protrude.

3. The latching mechanism shall be a 3-point draw roller type using an overlapping door design.

a) Pushrods will be turned edgewise at the outward supports and shall be .250 inch by .750 inch aluminum, minimum.

b) Rollers shall have a minimum diameter of .875 inch and will be made of nylon. The center catch shall be fabricated from .187 aluminum, minimum.

4. An operating handle shall be furnished.

a) The handle will be stainless steel with a 3/4-inch diameter shank.

b) The latching handle shall have a provision for padlocking in the closed position.

5. Each door shall be equipped with door restraint bars with automatic engage hardware.

D. Equipment Mounting:

1. Interior Panels

a) The enclosure shall be equipped with mounted full size divider back-to-back panels to form front and back compartments. Panels shall be constructed of 0.125 thick aluminum.

2. Provide stainless steel c-channel to support equipment as required.

E. Cabinet Finish:

1. The outside surface of the cabinet shall have a smooth, uniform, natural stainless steel finish.

F. Manufacturer:

1. Cabinet is to be manufactured by Hennessy Products, Inc., or an approved Hoffman.

2.09 WIND MONITORING SYSTEM

A. Wind Monitoring System shall consist of three devices:

1. Wind Monitor:

a) 0-100 mph

b) Wind Speed Accuracy: + or - .6 mph

c) Wind Direction Accuracy: + or - 3 Degrees.

d) Operating Temp. -50 to 50 degrees C.

e) 4-20 mA output

2. Wind Tracker:

a) Wind range: 0-100 mph

b) Wind Direction: 0 to 360 degrees, 36 points.

c) Inputs: 4 to 20 mA

d) Output 0-5VDC Full Scale for speed and direction.

e) Normally open contacts for speed and direction.

3. Surge Protection

B. Wind Monitor shall be as manufactured by R.M. Young Company, Model #05103LP or approved equal.

C. Wind Tracker shall be as manufactured by R.M. Young Company, Model #06201 or approved equal.

D. Surge protection shall be as manufactured by R.M. Young Company, Model #19120 or approved equal.

PART 3 EXECUTION

3.01. MOTOR CONTROL CENTER (MCC)

A. Install MCC in accordance with manufacturer's recommended procedures on concrete pads. Provide necessary protection during construction period to insure against mechanical damage and dust accumulation.

B. Field tests prior to energization:

C. Megger check of phase to phase and phase to ground insulation levels.

1. Continuity.

2. Short Circuit.

D. Adjust operating mechanism for free mechanical movement. Tighten bus connections and mechanical fasteners. Touch-up scratched or marred surfaces to match original finish.

3.02 MOTOR CONTROLS

A. Electrical Contractor shall provide starters and controllers complete with pilot lights, selector switches and identification for all motors specified or indicated.

1. Manual motor starters: Motors smaller than 1/2 HP except otherwise indicated.

2. Magnetic motor starters: Motor 1/2 HP and larger except otherwise indicated.

3. Mechanical Contractor will mount all control hardware provided by him.

4. Electrical Contractor shall provide proper size overload heaters, make all power connections to control components and wire all associated control devices, i.e., pilot lights, selector switches, etc.

3.03 MECHANICAL EQUIPMENT CONTROL WIRING

A. All control wiring related to the mechanical equipment automatic temperature control system shall be provided by the Mechanical Contractor.

B. Electrical Contractor shall provide all wiring conduit and final connections for the interlock and control wiring of all mechanical air handling equipment, exhaust fans and dampers.

3.04 EQUIPMENT CONTROL WIRING

A. Provide all wiring conduit and final connections for the interlock and control wiring of all equipment.

3.05 TELEPHONE DIALER SYSTEM INSTALLATION

A. Install telephone dialer equipment in accordance with Manufacturer's recommendations. Install equipment at proper location.

B. Programming in coordination with Owner's requirements shall be performed and demonstrated by Contractor.

C. Perform telephone service line connection.

3.06 LEVEL MONITORING SYSTEM: ROD SYSTEM

A. Coordinate length of rods with actual height of chemical feed tanks.

B. Provide all necessary hardware for proper mounting of level rods.

C. All materials used shall be rated for the chemical used for.

3.07 WIND MONITORING SYSTEM

A. Install all components as described in the specifications and drawings.

B. Calibrate wind monitor with wind tracker. Calibrate and test wind tracker with associated control panel.

C. Wind Monitor shall be mounted 10' above finished grade on a 1" dia. stainless steel pipe. Provide all stainless steel mounting hardware.

D. Provide surge protection between wind monitor and wind tracker.

END OF SECTION

SECTION 16910

ELECTRICAL CONTROLS

SYSTEM CONTROL PANEL

"SCP"

PART 1 GENERAL

1.01 SCOPE

A. Perform all work necessary and/or required and furnish all materials and equipment for complete system of electrical controls and instrumentation for the well pump and water tank. Such work includes, but is not limited to, the following:

1. Programmable Logic Controller with Graphic Operator Interface with all required components.
2. Contactors, relays, selector switches, pilot lights, etc.
3. Spray Irrigation Controls
4. Aerator Controls

1.02 GENERAL

A. The Contractor shall furnish and install the System Control Panel in accordance with this specification and as detailed on the applicable Contract Drawings. The PLC shall include but not to be limited to: a processor module (CPU), communications interface module, power supply, software for applications programming, operator interface system diagnostics, communications, data acquisition, and module racks. The PLC shall collect data, process control functions, communicate with other PLCs, distribute process information along the data highway, and may have their program down loaded from programmer's terminal, and be locally programmed from a portable programmer. The PLC shall have provisions for communicating unsolicited messages (report by exception) to an operator interface to reduce network traffic.

B. The PLC system shall be furnished by a single vendor who has actively been manufacturing programmable logic controllers of the required specified capabilities and whose products have operated successfully for a period of at least eight years.

C. All PLC equipment shall be UL and VDE listed.

D. The PLC system manufacturer shall maintain, as part of a national network, engineering service facilities within 200 miles of the Project, to provide start-up service, emergency service calls, repair work, service contracts, maintenance, and training of Department personnel. Emergency service shall be available within twenty-four hours of notification.

1.03 PANEL BUILDER AND PROGRAMMER

A. Panel builder shall have minimum 5 years prior experience and be capable of servicing the panel locally.

B. Panel shall be built and programmed by Galen Yoder Electrical Design or approved equal panel builder.

1.04 SHOP DRAWINGS

A. Furnish shop drawings and descriptive data, complete with project designation, for the following:

1. All components used to construct the panel.

2. Enclosure

3. Complete Ladder Wiring Diagrams showing devices, wiring and terminal blocks numbered and labeled.

4. Program for PLC

5. Front Panel Arrangement Drawing

6. Interior Arrangement Drawing.

7. Show all wire sizes for power distribution with in the panel.

B. Shop Drawings shall be submitted in a ring binder with dividers for each section listed under Paragraph 1.

1.05 SEQUENCE OF OPERATION

The System Control Panel shall incorporate controls for both the spray irrigation and aerator and shall operate in the following manner:

A. **Spray Irrigation**

1. General

a) All spray pumps in any combination shall be able to be interlocked with either/or or all Chlorine Feed Pumps during manual spraying operation of the SCP.

b) The SCP shall be capable of alternating the spray pumps every 24 hrs of pump running time with a manual override.

c) All interlocks and permissions shall be active during any spraying operation of the SCP. Operator **shall** be able to deactivate or bypass any interlocks or permissions.

d) Valves shall open fully first with confirm signal (normally closed contact on the valve) before SCP starts pumps in variable sequences up to 5 minutes and timers. If after a time delay of 3 minutes (adjustable from 30 sec to 3 minutes) conformation of the closing of one valve has not been received, the SCP shall stop the pumps (chlorine and spray) and shall visually and audibly alarm ("valve trouble").

2. Manual/Automatic Spraying Operations: The SCP shall be capable of the following operations:

a) Manual (system selector switch set to manual): *Note system in manual will continually run until the operator intervenes.*

1) Select spray pump(s), chlorine pump(s) and spray field(s) by turning the appropriate selector switch to the "enable" position.

2) Push system start push button to begin.

3) SCP will open selected valve(s) and start selected spray pump(s) and chlorine feed pump(s). Pumping will continue until the operator intervenes.

4) In the event permissions deactivate the SCP, the SCP shall stop spray pump(s) and chlorine feed pump(s) and shall close valve(s). SCP shall reset automatically, ready for next operator assisted start. The SCP shall visually indicate which permission alarmed and shall not allow operation until condition has been acknowledged.

b) Automatic(system selector switch set to automatic, on cycle)

1) Select spray pump(s), chlorine pump(s) and spray field(s) by turning the appropriate selector switch to the "enable" position.

2) Set start time period (24 hour clock)

3) Set length of time for system to irrigate, adjustable from 1 to 24 hrs in 5-minute increments.

4) Push system start push button to begin.

5) At the selected start time, the SCP will open valve(s) and start spray pump(s) and chlorine feed pump(s).

6) SCP shall continue to irrigate until the length of time has been completed. At the end of one cycle system shall rest (pumps turn off) for the pre-set time.

7) Pumping will continue until operator intervention or a permission changes state. In the event permissions deactivate the SCP, the SCP shall stop spray pump(s), stop chlorine feed pump(s) and shall close

valve(s). The SCP shall visually indicate which permission alarmed and shall not allow operation until condition has been corrected. SCP shall reset automatically, ready for next assisted start, once condition has been corrected.

8) In the event of a power outage, the SCP shall keep track of it's progress and begin where it left off once power (normal or standby) has been restored. Automatic restart shall be delayed 5 minutes.

9) Chlorine Feed: In the event the chlorine tank becomes empty, the SCP shall stop all spraying, close all valves, visually indicate the chlorine tank is empty and shall sound an alarm both visually and audibly.

3. Interlocks

a) Chlorine Feed

b) Any spray pump(s) with any chlorine pump(s).

c) Note: The spray pumps shall not be allowed to operate without a chlorine feed pump unless operator physically overrides this function.

4. Permissions - SCP shall be permitted to operate under the following conditions:

a) Wind Monitor: Wind speeds as directed by Township and through gusts exceeding preset speed for up to one minute. Wind Direction and capability to set different wind speed alarm points for different wind directions.

b) Lagoon Low Level (Control Manhole): Water level above a pre-set low water level.

c) System pressure is between a pre-set "low" pressure and a pre-set "high" pressure.

d) Chlorine Tank is not empty (operator overridable).

e) A Valve or valves are confirmed open.

5. Alarm Points:

a) System Control Panel:

1) All permissions shall become alarms if defined parameters have been exceeded.

2) All alarms shall signal both visually and audibly at the control panel. An alarm acknowledge push button shall be provided to silence the audible alarm. An alarm reset button shall be provided to clear existing alarms. The alarms shall be resettable if unless the condition

causing the alarm has not been corrected but the system shall shut down as designed if any alarm recurs

3) For the following alarm points, as selected by the township, a general alarm shall be sent to the auto-dialer in addition to locally visually and audibly signaling:

   (a) Low level the Chlorine Feed Tank

   (b) High Water Level Storage Lagoon

   (c) Low Water Level Storage Lagoon

   (d) High System Pressure

   (e) Low System Pressure

   (f) Spray Pump Failure

   (g) Valve Trouble

4) For the following alarm points, an individual alarm shall be sent to the auto-dialer in addition to locally visually and audibly signaling:

   (a) High Wind

6. Panel Construction

a) Devices mounted on front cover. Provide the following:

1) Selector switches for the following:

   (a) System (Manual, Automatic)

   (b) Spray Pump (s) (disable, enable)(Typical for each)

   (c) Chlorine Pump (s) (disable, enable) (Typical for each)

   (d) Spray Field (s) (disable, enable) (Typical for each)

2) Push Buttons for the following:

   (a) System Start (black push button)

   (b) System Stop (large red push button)

   (c) Alarm Acknowledge (black)

   (d) Alarm Reset (black)

3) Pilot Lights for the following:

   (a) Green:

      (i) System Run – “on” (Manual or Automatic Activated)

(ii) Spray Pump (s) – "on" (only when running) (Typical for each)

(iii) Spray Field Valve (s) Open (only upon confirmation) (Typical for each)

(iv) Chemical feed pump (s) – "on" (only when running) (Typical for each)

(b) Amber

(i) Spray Field Valve (s) Closed (only upon confirmation) (Typical for each)

(c) Red:

(i) Low Level for Chlorine Tank

(ii) High Water Level Storage Lagoon #1 (adjustable)

(iii) Low Water Level Storage Lagoon #1 (adjustable)

(iv) Spray Pump (s) – Trouble (called for, no flow, low pressure) (Typical for each)

(v) High Wind

(vi) Low System Pressure (time delay)

(vii) High System Pressure

(viii) Valve Trouble (called for but not open, time delay)(typical for all valves)

4) Misc. Items:

(a) Low Pressure Alarm Delay Timer

(b) Wind Direction Alarm Delay Timer (can be inside panel).

(c) Potentiometer for each time setting: for each spray fields, one rest period, manual time cycle.

(d) Potentiometer with a LCD readout for Low Pressure Setting

(e) Potentiometer with a LCD readout for High Pressure Setting

(f) Bargraph for level monitoring for Lagoon #1 (Control Manhole)

(g) LCD Readout for System Pressure.(lbs)

(h) LCD Readout for total system flow.(gpm)

(i) LCD Readout for flow through each spray field (gpm)

(j) LCD Readout for count down of time for a given spray field. (minutes).

(k) Audible horn.

(l) Wind Tracker

5) Inputs to the PLC: The following are inputs necessary to perform the sequence of operation. Please note other inputs may be required that are not listed.

(a) Analog

(i) Effluent Flow Meter

(ii) Lagoon Level Transducer (Control Manhole)

(iii) System Pressure Transducer

(iv) Potentiometers for time settings as described in 2.06 E. 1. d).

(v) Potentiometers for low and high-pressure settings as described in 2.06 E. 1. d).

(b) Digital Inputs

(i) Wind Speed (above alarm speed)

(ii) Wind Direction

(iii) Strainer (trouble)

(iv) Chlorine Tank Level Sensor

(v) All Selector Switches and Push Buttons described in 2.06 E. 1. a) & b).

6) Outputs from the PLC: The following are outputs necessary to perform the sequence of operation. Please note other inputs may be required that are not listed.

(a) Analog

(i) LCD Readouts as described in 2.06 E. 1. d).

(b) Digital Outputs

(i) Spray Pumps 1,2

(ii) Chlorine Pumps 1,2

(iii) All Pilot Lights described in Section 13110

(iv) All Alarm Points described in Section 13110.

7) Auto Dialer as described in Section 13110.

8) Communication Network (through dial-up connection)

9) Inputs from Valve Control Panel (located at remote valve building) or directly for local valves:

(a) Open and close confirmation of each valve

(b) Local Disable/Enable for each valve

10) Outputs to Valve Control Panel (located at remote valve building) or directly for local valves:

(a) Open and Close of each valve.

B. **Aerator Controls**

1. General

a) Aerator Heat Blankets shall come on and off automatically subject to outside air temperature. A preset (typically 40 degrees Fahrenheit) outside temperature or lower shall activate Aerator Heat Blankets.

b) Aerator Heat Blankets shall not be allowed to run if the aerator is off (via auxiliary contact on aerator motor starter). Provide on/off bypass for maintenance purposes only.

c) Phase monitor shall deactivate all aerators and heat blankets in the event of a phase failure, low voltage or reversal of phases.

2. Manual

a) Aerators shall run continuously.

3. Automatic:

a) Aerator shall activate at pre-set time and continue to run for a pre-set time period (less than 24 hrs). Cycle shall repeat every day.

b) Each Aerator shall be individually controlled.

c) In the event of a power outage the following shall happen:

1) Aerators shall restart automatically. Re-starting shall be staggered by 10-second intervals.

2) Timed cycle shall continue where power outage interrupted.

4. Panel Construction

a) Devices mounted on front cover. Provide the following:

1) Selector switches for the following:

(a) Hand, Off, Auto (typical for each Aerators)

2) Pilot Lights for the following:

(a) Green: System – "on" (processor powered)

(b) White: temperature below preset degrees heaters activated.

(c) Green: Aerator Running (typical for each aerator)

(d) Red/Flashing: Aerator Trouble (called for, but aux. contact not closed)(typical for each aerator)

(e) Red/Flashing: General Trouble (Phase trouble)

3) Misc. Items:

(a) Operator interface for start time of aerator and length of running time. (typical for each aerator)

(b) Elapse time meter (typical for each aerator)

(c) Ammeter (typical for each aerator)

(d) Phase Monitor

(e) Exterior temperature sensor: Provide NEMA 4X outdoor sensor. Integrate with panel as required. Provide conduit and wiring as required.

PART 2 PRODUCTS

2.01 GENERAL PANEL CONSTRUCTION

A. Provide NEMA 12 stainless steel enclosure for the control system indicated of size as with comfortable room for interior and cover mounted components. Enclosure shall be manufacturer by Hoffman, Wiegmann or approved equal.

B. Panel is to be furnished with graphic operator interface showing all the control devices stated in this specification.

C. Engraved laminated plastic nameplates shall be furnished for each front panel and interior mounted devices. All instruments, components and wiring shall be tagged with embossed plastic tape labels. Nameplates shall be provided for each module, device and equipment with appropriate data such as equipment number, rating, serial number, and manufacturer.

D. Wiring:

1. Neatly installed in plastic wiring troughs. Provide safety barriers where required by safety. All wiring shall be identified at both ends by wire markers.

2. All field wiring shall be terminated to terminal block, which will permit pre-wiring of the module, or removal and replacement of a module without disturbing the field wiring or any other I/O modules.

3. All discrete I/O wiring shall be minimum No 14 AWG, RHW-2, 600 volt.

E. Provide surge protection for all wiring from devices outside the control building. Surge protection shall be grounded as per manufacturers recommendation.

F. Panel control logic shall utilize a programmable logic controller as specified here in.

G. Power Distribution

1. Panel shall be pre-wired to accept a single-phase 120-volt power supply capable of powering all controls and instrumentation with master disconnecting means.

2. Panel shall have a Main Circuit Breaker.

3. Provide fused low voltage supply (24VDC) for all components requiring low voltage.

4. This panel shall not provide power distribution for aerators, aerator heaters, spray pumps etc.

H. *Provide relays as described in this section for all external outputs of the PLC which will exceed the contact rating of the digital outputs on the PLC.*

2.02 RELAYS AND CONTACTORS

A. Relays:

1. Type: Electro-magnetically operated and held type, single or multiple poles as indicated.

2. Contacts: Silvered alloy, double break, convertible type.

3. Rating: 10 amperes non-inductive load.

4. Accessories: Mechanical latch and pneumatic timer attachments as indicated.

5. Manufacturer: Square "D" Class 8501, Type K or equal General Electric or Gould-ITE.

B. Contactors:

1. Type: Multiple, electrically operated, mechanically held with coil clearing contacts.

2. Manufacturer: Square “D” Class 8903 or equal General Electric or Gould-ITE.

2.03 INDICATING DEVICES AND CONTROL OPERATORS

A. General: *All devices and control operators mentioned in this specification shall be virtually simulated with the graphics operator interface.*

B. Indicating Devices:

1. Elapsed time meters shall be six digits with tenths of an hour.
2. Pilot lights.
3. LCD indicators for flow and pressure read-outs.
4. Bar graph for level in feet.
5. Ammeter

2.04 PROGRAMMABLE LOGICAL CONTROLLER

A. Programmable Logical Controller shall have the following:

1. Inputs/Outputs as required and as necessary to facilitate the sequence of operation. Provide capacity for future expansion with 20% spare.
2. Memory as required with spare capacity for future growth.
3. 120V power supply with 24-hour battery back up both for CMOS and resident programs. PLC shall be capable of retaining all data even with a power outage.
4. Surge protection for the PLC as recommended by Manufacturer.

B. Communications - Provide for the following:

1. Port for download/upload programming.
2. Modem for offsite access.
3. DH+ for communications of other system panels and/or devices.

C. Programming of the PLC shall be done by the Panel Builder and shall be complete and tested before installation of the system control panel.

D. Provide all necessary components for a complete installation.

E. All components to interface with the PLC shall be as recommended by the PLC manufacturer. These items shall included but not limited to modem, operator interfaces, all communications methods, etc.

F. Manufacturer: Rockwell Automation/Allen Bradley SLC-500 series

2.05 COLOR GRAPHICAL OPERATOR INTERFACE

A. Graphical interface shall operate and report all functions as specified in this section. Interface shall be “touch screen” type and programmed for ease of use.

B. Display shall be back-lit 256 color TFT LCD 10.4" (640 x 480 resolution).

C. Data entry shall be via touch sensitive screen with 16 touch sensitive keys.

D. Communications shall be but not limited to RS232 port, DH-485.

E. Provide all necessary components for a complete installation.

F. ***Provide operator/owner with all software required customizing and program configure Graphical Operator Interface.***

G. Manufacturer: Allen-Bradley "PanelView" 900 series.

PART 3 EXECUTION

3.01 SYSTEM CONTROL PANEL

A. Install all components as described in the specifications and drawings.

B. Programming of the PLC shall be done by the Panel Builder and shall be complete and tested before installation of the system control panel. Review programming with Engineer prior to shipment. Review all graphical interface screens prior to shipment with the Engineer.

C. Test the control panel for complete proper operation prior to shipment. Complete operation shall be demonstrated to the owner and Engineer prior to shipment. Notify Engineer five (5) working days before demonstration is conducted. Conduct demonstration in presence of Engineer or authorized representative. Repeat demonstration after defects are corrected.

D. Test the control panel for complete proper operation after installation. Calibrate all LCD readout devices, pressure sensors, and level sensors. *Simulate <u>all</u> operating and alarm conditions.* Notify Engineer five (5) working days before calibration and simulation is conducted. Conduct calibration and simulation in presence of Engineer or authorized representative. Repeat calibration and simulation after defects are corrected.

E. Start-up shall be performed with factory representative present. Provide minimum of 16 hours for factory representative during start-up.

F. Provide training for Owner's Representative (4 hours).

END OF SECTION

ATTACHMENT A

SPECIAL CONSIDERATIONS FOR WATER AND SEWER

SYSTEMS IN CARBONATE GEOLOGICAL AREAS

PART I GENERAL

1.01 PURPOSE

A. Construction of any facility in areas underlain by carbonate geology require special design and construction considerations.

B. The following standards are meant to provide guidance and a minimum standard for water and sewer systems in areas of carbonate geology.

C. Each site is different and may require consideration and additional measures above what is presented here and these standards are not meant to relieve the Applicant or Contractor from fully exploring the characteristics of the site and developing measures to avoid environmental problems associated with carbonate geology.

D. These Standards are not meant to supercede Township Ordinance No. 94-06, only to provide more detailed Standards for water and sewage facilities in carbonate areas.

1.02 FIELD EXPLORATION/GEOTECHNICAL EVALUATION AND REPORT

A. Field exploration shall involve an overall exploration of the entire site to supplement any existing subsurface data, as well as a focused investigation of any special concerns identified by the Township or others.

B. The exploration shall include stereoscopic analysis of aerial photographs for geologic features, percussion probes, test borings, and laboratory testing and other measures determined to be appropriate for the site. The resulting subsurface soil, rock and groundwater data shall be correlated to any previous work and published geologic information. Findings are to be presented along with geotechnical recommendations regarding sinkhole repair; lagoon liner design; water storage, subgrade preparation; construction testing and inspection; and structural fill.

C. Prior to initiating field explorations, recent aerial photographs of the site shall be obtained for stereoscopic analysis. The topography of the land shall be checked in 3-D and scanned for circular depressions or lineaments potentially related to sinkhole activity, which might not otherwise be visible from the ground. A copy of the photos and interpretation shall be supplied to the Township,

D. All of the probes shall be taken into the bedrock. Drilling through the overburden shall be accomplished using air pressure and rotation only. Field observations by a qualified geologist shall be provided for the following:

- Relative drilling resistance;
- Hammer use;
- Cuttings recovery;
- Air pressure interaction between adjacent holes;
- Material descriptions and strata divisions;
- Approximate groundwater levels; and
- Potential raveled zones and/or materials having a low resistance.

E. After digesting the information from the percussion probes, test borings shall be conducted to: (1) better characterize the area; (2) investigate any sand and gravel deposit; (3) obtain samples for laboratory testing; and (4) generally correlate the relative percussion drilling resistance in different soil types to the N-values of the standard penetration test – SPT, per ASTM D1586. Boring logs shall be provided as part of the report.

F. All of the samples obtained from the latest borings shall be visually classified and assigned USCS designations. Selective samples shall be tested in the laboratory to determine final USCS group names.

G. Reliable groundwater measurements shall be taken from the test borings and provisions made for taking measurements over an extended period of time to determine seasonal peaks in the groundwater.

1.03 LAGOON CONSTRUCTION

A. Subgrade Preparation for Lagoons

1. Proofrolling – All topsoil shall be removed from the construction area. Upon reaching final subgrade elevations along the bottom of the lagoon, the cut soils should be proofrolled under the supervision of a geotechnical engineer with a 20-ton (static weight) vibratory, sheepsfoot roller compactor. The objectives of this operation are to prepare the subgrade for the geogrid and liner system, evaluate its stability, and identify any unsuitable areas caused by high moisture or sinkhole activity not detected in the field explorations. At least 20 passes in full vibratory mode are recommended. Soft subgrade attributed to high moisture should be corrected under the direction of the inspecting engineer through aeration and compaction or excavation and replacement with an approved fill. Any spots of suspected sinkhole activity should be investigated by a geotechnical engineer to see if a repair is needed.

2. A biaxial geogrid between the Hypalon liner system and the prepared subgrade may be required by engineer. Such reinforcement would help bridge any variable stiffness in the supporting subgrade, provide extra strength to the system, and minimize potential differential settlements. The recommended

biaxial geogrid type is Tensar BX1100 or better, with the following minimum properties.

3. To divert runoff away from the lagoon, a drainage swale on the uphill side shall be provided. To alleviate any perched water, which could develop in the subsurface, a curtain drain is recommended. A perforated pipe inside of a 2-ft wide stone-filled trench should be installed along the ends and upstream sides to intercept seepage. The invert of the pipe should be a minimum of 3 ft. below the bottom of the Hypalon and be drained to a gravity type outlet structure. At least three monitoring wells are recommended to be installed at the start of construction in an area, which will not be disturbed by site grading, for long-term monitoring of potential perched groundwater.

4. All structural fill should be free of topsoil, organics, debris, and cobbles larger than six inches. Sandy soils could be used to build the berms, but it is important to not alternate lifts of clay and sand, since water can become trapped in the sandy layers. Raking or screening of the bottom subgrade may be needed to remove gravel, depending on the sensitivity of the Hypalon system and the manufacturer's guidelines.

5. Approved structural fill should be placed on compacted and stable subgrade approved by the inspecting engineer. The recommended lift thickness is 6 inches when light duty compactors are used or ten inches when heavy-duty roller compactors are used. A sheepsfoot roller would prove effective for the silty and clayey soils. Note that benching is required to "key in" new fills with existing soils where existing grades are steeper than 10H:1V. Compacted structural fill should be tested in the field using a nuclear gauge and the methods of ASTM D2922. The controlling basis should be in the standard Proctor (ASTM D698). Water content should be kept within $\pm$2% of optimum. In-place dry density should meet the minimums tabulated below, as compared against the standard Proctor density.

Table 1. Recommended Minimum Compactions

Use	Minimum % of Standard Proctor Density*
Lagoon Bottom	98
Berm	98
Keyway	98
Utility trench backfill	98
Under structures such as endwalls	100

*Manufacturer's guidelines should govern in place of these values if provided.

B. GROUTING

Compaction Grouting – This technique involves the injection of low slump (inch or less) cement grout into the ground to seal off the opening(s) in the rock causing the problem and densify and reinforce raveled soils. Percussion drilling is used to install 2-inch diameter steel injection pipes ten feet into the rock. The points are designated as primary, secondary or tertiary, according to their arrangement and progress of the operation. Depending on the "take" of the primary holes, the secondary and tertiary pipes might not be needed. Grout is pumped while lifting the pipes in stages to treat the targeted zones. A stage is complete when a cutoff volume of grout is injected, the resting back pressure reaches 200 psi, or the ground heave exceeds 1 ½" inches. The end result is a grid of grout columns with densified soils between them. Upon completion of grouting, SPT borings are performed to verify the performance of the repair.

1.03 OTHER SITE IMPROVEMENTS

A. Based on the geotechnical evaluation of the site, the area shall be classified into the following categories pertaining to the precautions needed for the construction of any structures:

1. No additional effort needed.

Areas given in this recommendation do not require any additional effort other than the general practices for constructing in carbonate areas and as follows. Performing hand augers below footing subgrades to detect possible unsuitable materials at the time of foundation excavation. Hand auger probes should be performed by the geotechnical engineer at 15 to 20 ft. intervals along wall footings. To a depth of at least five feet below the design bearing grade to detect localized soft subgrade soils and possible enhanced weathered zones. Where relatively soft natural soils are encountered, footing subgrades should be undercut. Footing subgrades requiring undercuts may be backfilled to original design subgrade elevation with lean concrete dense graded crushed stone

meeting the gradational requirements of PennDOT size No. 2A aggregate or new compacted structural fill. It should be noted that concrete backfill will only be acceptable where the soft material has been completely removed.

It should be remembered in developing areas denoted "no Additional Effort" that there will always be some risk of future sinkhole formation. However, by taking these precautions during design and construction, the probability of dealing with sinkhole development can be reduced. General site development and building design can incorporate measures to limit the potential for water infiltration around the building so that future risk of problems can be minimized.

Final design plans should also incorporate precautionary measures that will inhibit surface water infiltration including the following: (A) providing watertight storm drains; (b) roof drains that tie directly into the storm drainage system or are drained away from homes; (c) utilities that do not run along footing lines; (d) constructing drains around basement walls and discharging water, including water from sumps, away from the buildings; (e) sealing of pavement curbs and catch basins; (F) Minimizing low areas near houses that may hold water and promoting drainage away from homes; (G) minimizing large landscaped areas adjacent to buildings that require frequent watering: (H) Avoidance of unpaved swales and unlined retention basins: and (I) providing grading for positive drainage away from building areas.

2. Grade Beams

Areas with this recommendation are believed to require some additional effort to limit potential impact of karstic features. We recommend cast-in-place basement walls and grade beams. The intent behind recommending grade beams is to limit differential settlement of the foundation in the presence of minor subsidence by connecting perimeter strip footings and interior columns. The grade beam is not intended to span the distance of a karstic feature due to the fact that it is difficult to predict the size of a "design karstic feature". The structural engineer should design grade beams for units with this recommendation.

3. Exploratory Grouting and Mat Foundations

Areas with this designation are considered to have the potential for significant karst development. This option consists of drilling five exploratory holes five feet into bedrock within the footprint of each structure (one at each corner and one in the center). These holes should be filled with limited mobility grout (LMG). Prior to drilling, structure selected for this mitigation option must be surveyed to locate the proposed building footprints. This process of drilling and grouting will provide a more location-specific exploration of the subsurface conditions at each unit. Drilling rates, along with grout volumes and pump pressures, should be carefully monitored by the geotechnical engineer during the Contractor's operations. Once completed, the drilling and grouting logs

should b evaluated by the geotechnical engineer so a proper course of action can be selected. If the results are favorable, i.e., low grout takes and few soft zones during drilling in the opinion of the geotechnical engineer, the unit will not need further grouting. At this time, the unit can be constructed on a mat foundation with cast-in-place concrete walls. If the exploratory grouting program indicates high grout takes and soft zones in the opinion of the geotechnical engineer, additional grout holes will be required. The location and spacing of the additional grout holes will be determined on a unit by unit basis by the geotechnical engineer. The geotechnical engineer will evaluate the additional grout holes prior to mat foundation construction.

4. Ground Improvement or Deep Foundation System

   This option consisted of an intense grouting program for support of the structure on deep foundation elements.

B. Roadways

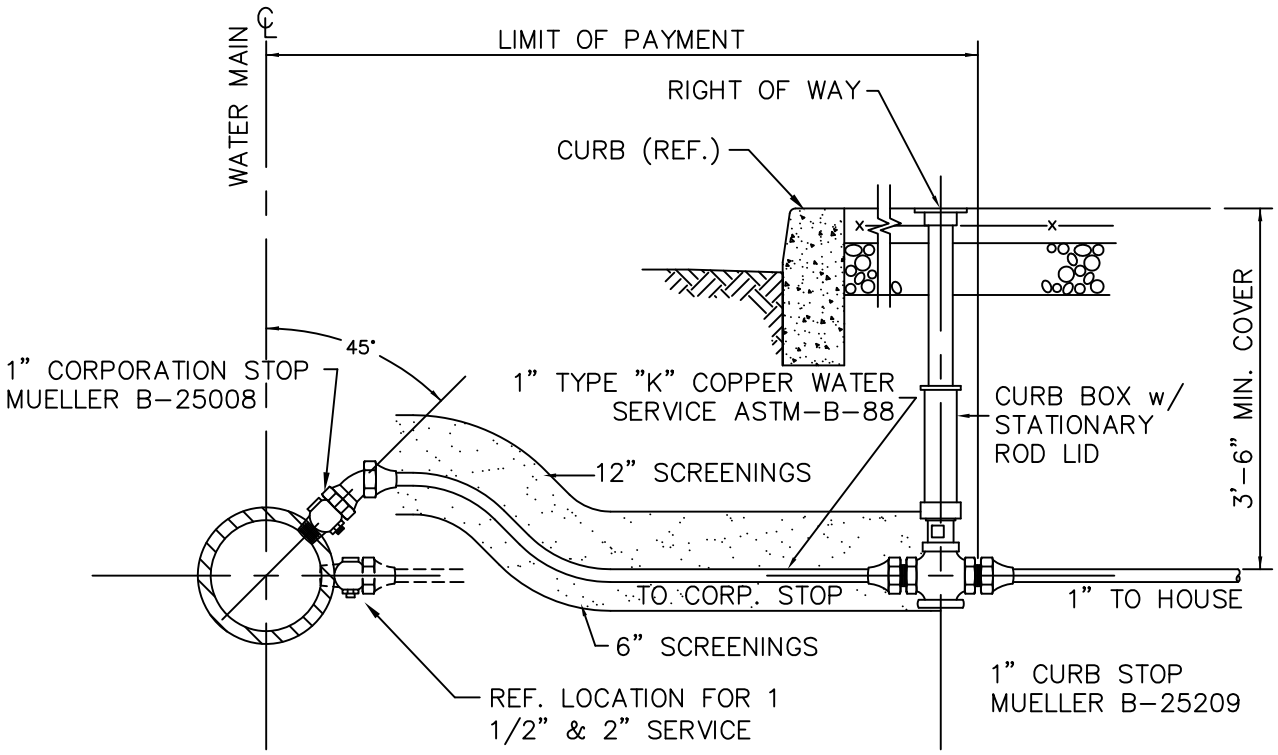
Any portions of roads or driveways that are within 50 feet of a delineated closed depression should be excavated to a depth of three feet below proposed subgrade elevation to remove possible soft surfical soils. A layer of geogrid should then be placed across the entire excavated area, and the excavation should be backfilled with structural fill to design subgrade elevation. Tensar BX-1100 structural geogrid or equivalent be used for this application. In addition, a layer of geogrid should be placed on the subgrade prior to placing and compacting roadway subbase material. This geogrid layer should span the entire width of the roadway.

C. Pipe Lines

Prior to installation of underground transmission lines and pipelines, auger borings (four (4) inch minimum) shall be made along all proposed underground conduit utility lines, wastewater lines, water lines, pipelines and stormwater and sanitary sewer lines at an interval of fifty (50) feet. These borings shall be drilled to a minimum of two (2) feet below bottom of the pipe or conduit. Pipelines and conduit shall be laid out so that they do not intersect rock surface pinnacles, sinkholes, fissures, lineaments, faults, fracture traces, or caverns.

A dike of clay or other suitable material shall be constructed across the width of the trench at intervals of twenty (20) feet or less along all underground conduits utility lines, wastewater lines, water lines, pipelines, and stormwater and sanitary sewer lines.

END OF SECTION



NOTE:
WATER SERVICE LINE SHALL HAVE 6" OF SCREENINGS SURROUNDING PIPE EXCEPT WHERE NOTED.

CASTLE VALLEY CONSULTANTS	**BUCKINGHAM TOWNSHIP**	**G-01**
SCALE: NOT TO SCALE	**STANDARD DETAIL**	
DATE: 02/25/2013	**RESIDENTIAL WATER SERVICE CONNECTION DETAIL**	REV. 1

CASTLE VALLEY CONSULTANTS

SCALE: NOT TO SCALE

DATE: 07/30/04

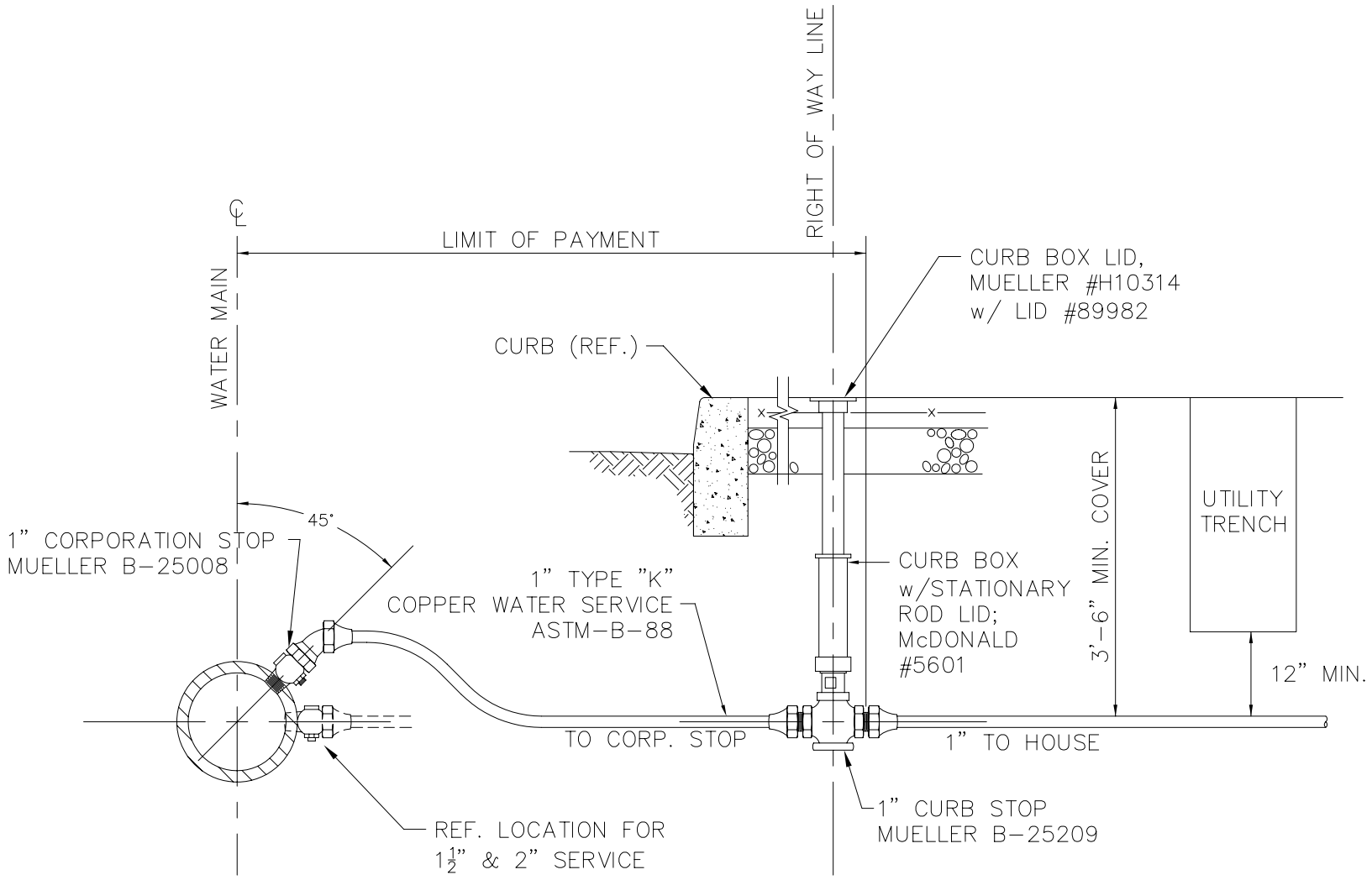
BUCKINGHAM TOWNSHIP

STANDARD DETAIL

RESIDENTIAL WATER SERVICE LINE w/ FIRE SPRINKLERS

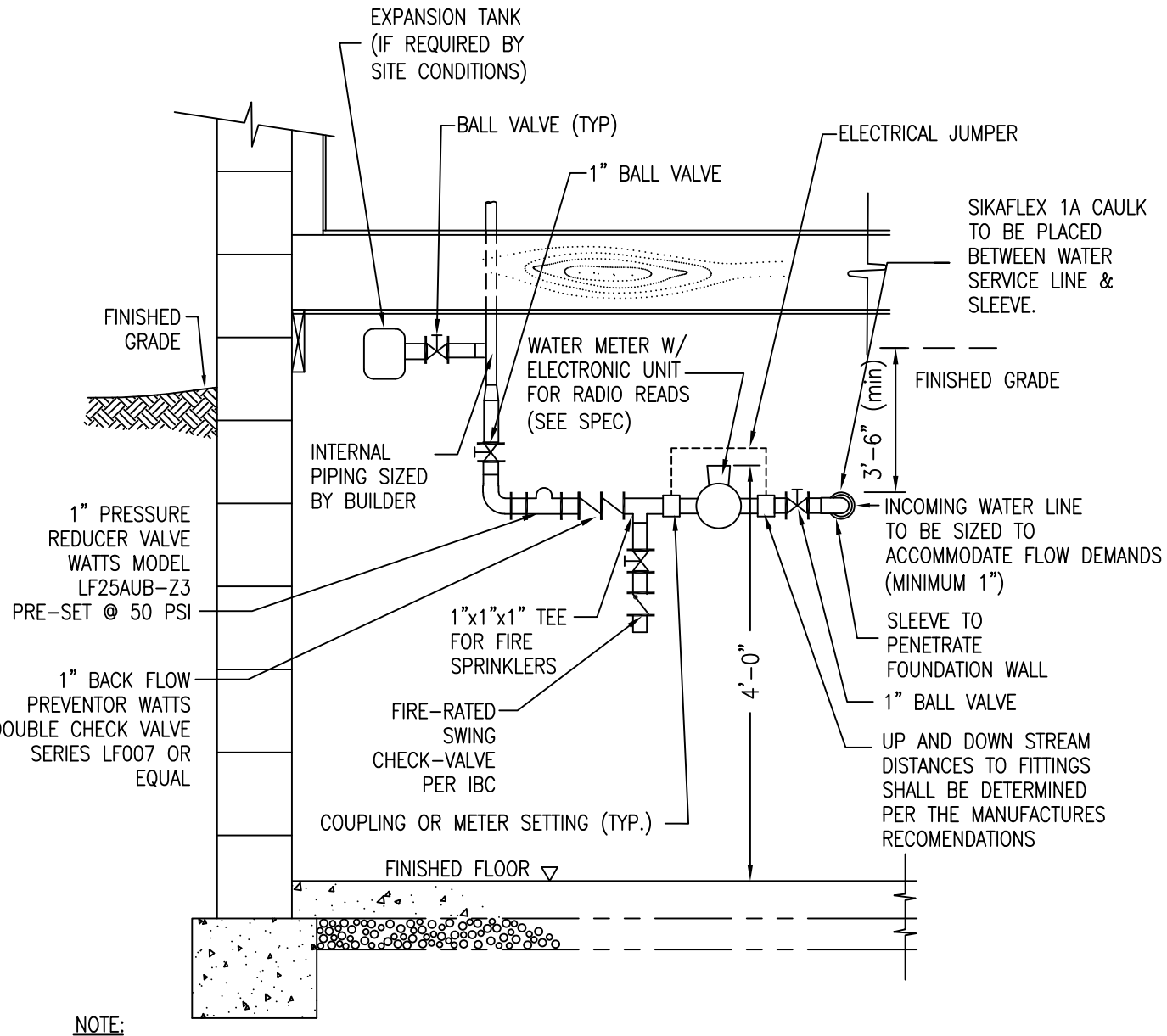
G-02

REV. 0



NOTE:

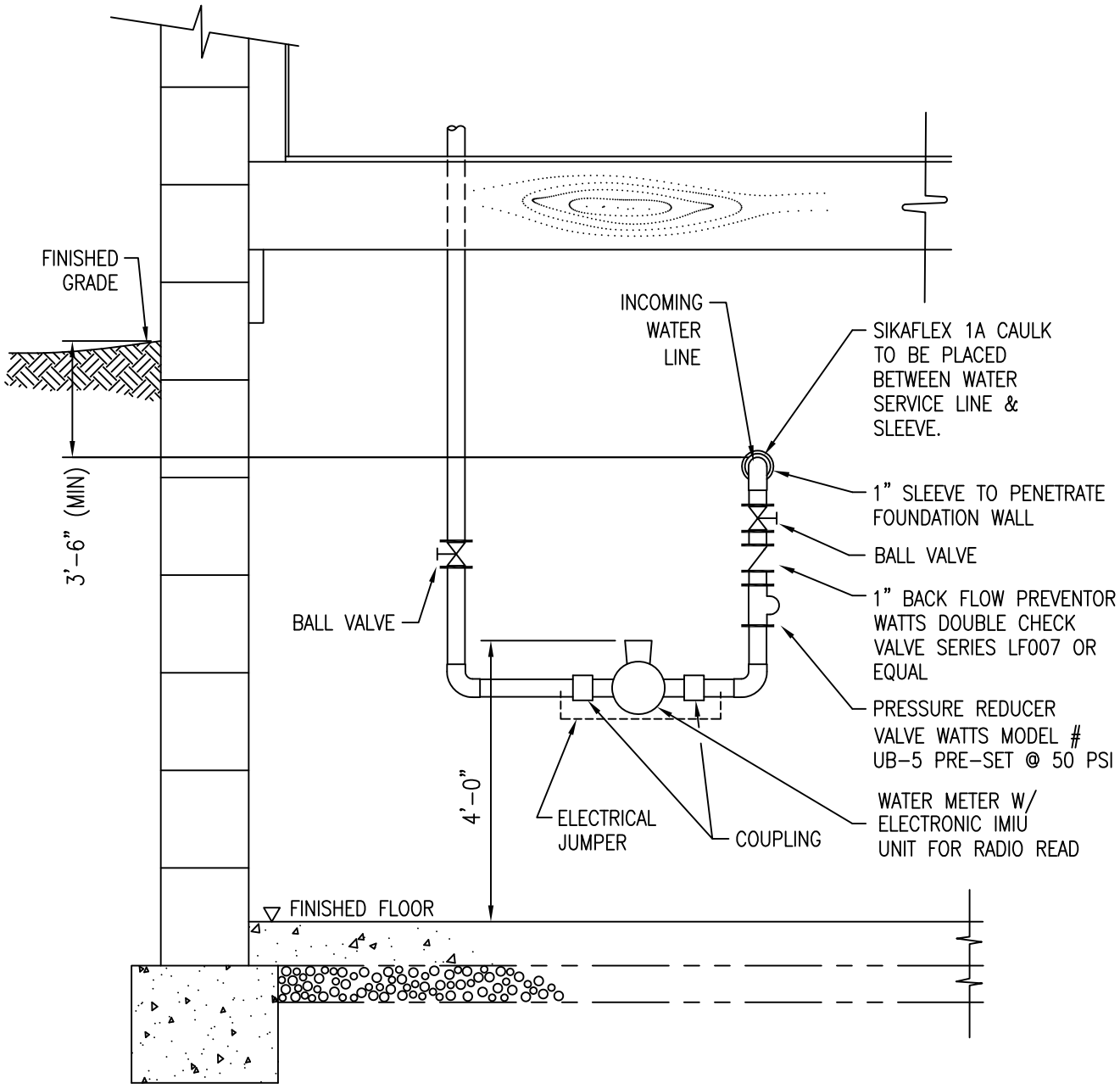
1.) WATER SERVICE LINE SHALL HAVE 6" OF SCREENINGS SURROUNDING PIPE.
2.) CONNECTIONS LARGER THAN ONE (1) INCH REQUIRE UPGRADE IN WATERMAIN CLASS OR "DOUBLE STRAP" DUCTILE IRON SERVICE SADDLES, MUELLER #DN2S (or Approved Equal) OR BOTH.
ONE (1) INCH SERVICE REQUIRES CLASS 54 8 INCH D.I.P. (minimum).
THE TOWNSHIP ENGINEER SHALL MAKE FINAL DETERMINATIONS OF OTHER PROPOSED CONNECTIONS.



NOTE:

- INLET BALL VALVE AND PRESSURE REGULATING VALVE MAY BE MOUNTED VERTICALLY IN ORDER TO MAINTAIN THE 4'-0" DISTANCE ABOVE THE FLOOR
- METER MUST BE MOUNTED IN THE HORIZONTAL POSITION.
- METER AND REMOTE TO BE SUPPLIED BY INSTALLER TO MEET TOWNSHIP SPECIFICATIONS.
- IT IS THE RESPONSIBILITY OF THE DEVELOPER TO DETERMINE IF THE OPTIONAL EXPANSION TANK IS NEEDED
- METER SETTING / COUPLING TO PROVIDE FOR EASY REMOVAL OF METER.
- ALL COMPONENTS MUST BE CERTIFIED TO MEET OR EXCEED AWWA OR ASCE SPECIFICATIONS.
- SERVICE TO THE 1" MINIMUM OR LARGER AS DETERMINED BY FIRE SPRINKLER DESIGN ENGINEER.
- PIPING TO BE INDEPENDENTLY SUPPORTED FROM METER (WALL OR FLOOR) SO METER REMOVAL WILL NOT DISTURB PIPING

CASTLE VALLEY CONSULTANTS	**BUCKINGHAM TOWNSHIP**	**G-03**
SCALE: NOT TO SCALE	**STANDARD DETAIL**	
DATE: 01/2023	**RESIDENTIAL WATER METER CON. DETAIL WITH FIRE SPRINKLERS**	REV. 3

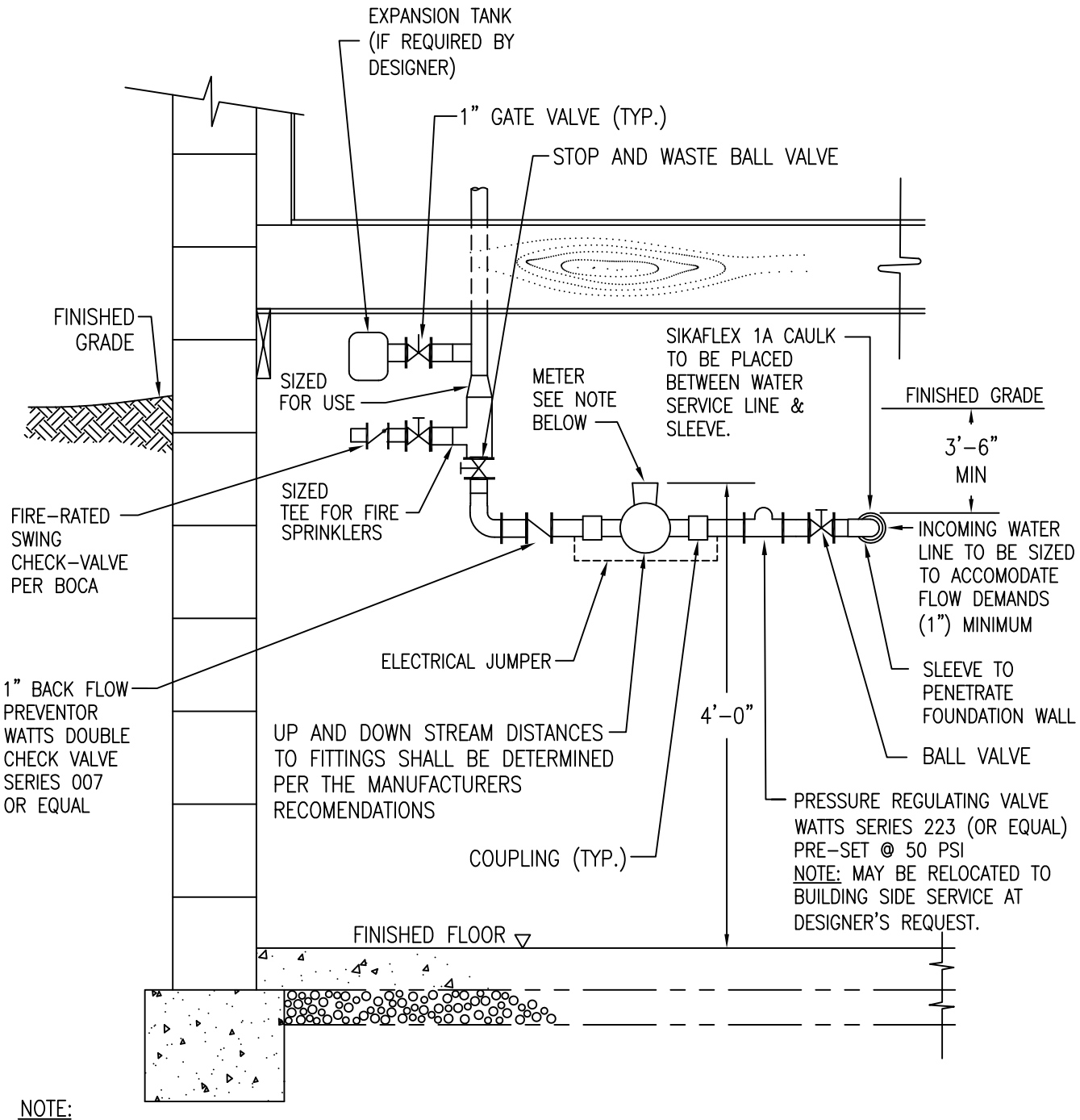


NOTE:

INLET BALL VALVE AND PRESSURE REGULATING VALVE MAY BE MOUNTED VERTICALLY TO MAINTAIN THE 4'-0" REQUIRED DISTANCE FROM FLOOR.

- METER MUST BE MOUNTED IN HORIZONTAL POSITION.
- METER SHALL BE PER BUCKINGHAM TOWNSHIP SPECIFICATION.
- PIPING WILL BE INDEPENDENTLY SUPPORT (FLOOR OR WALL) TO ALLOW FOR METER REMOVAL

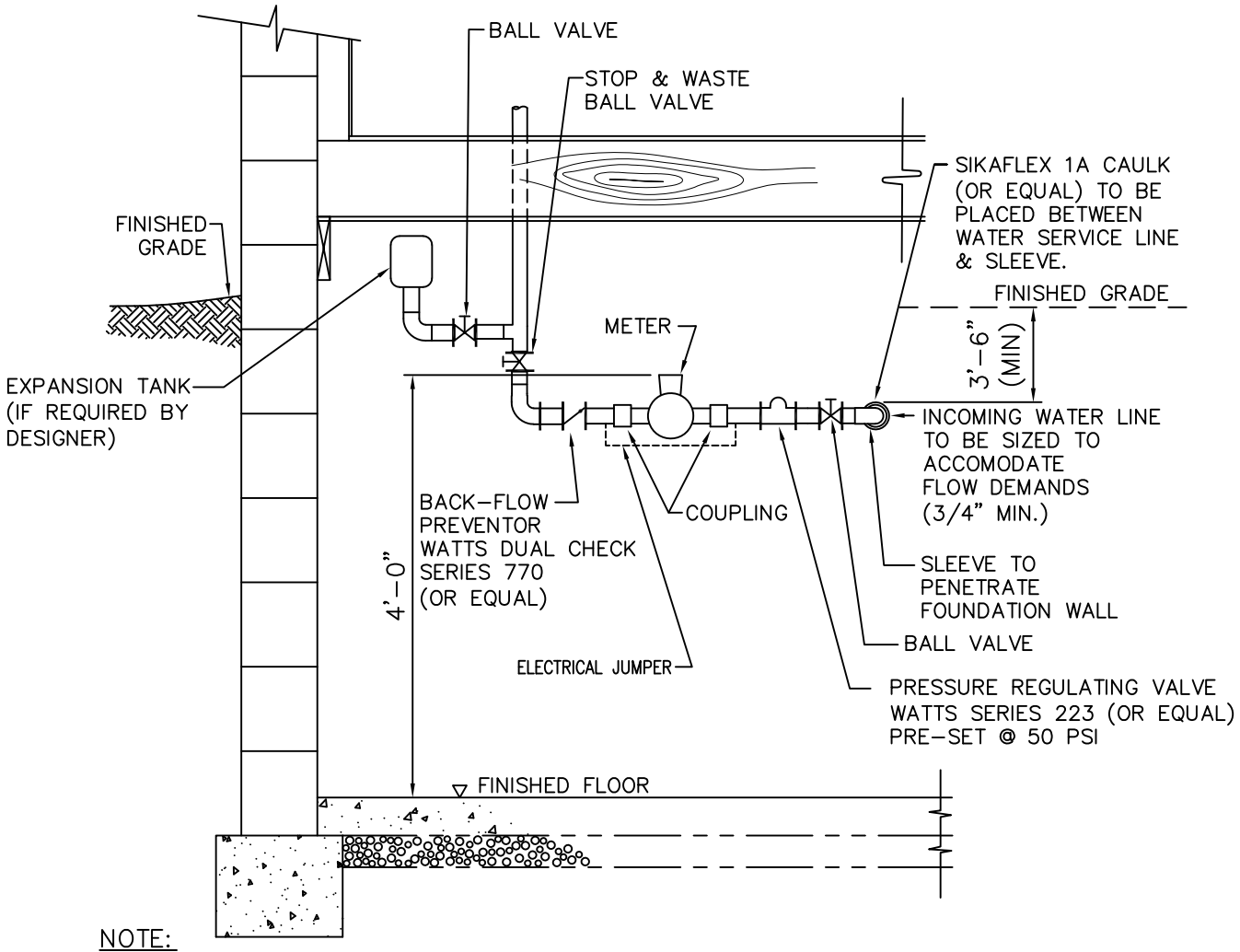
CASTLE VALLEY CONSULTANTS	**BUCKINGHAM TOWNSHIP**	**G-04**
SCALE: NOT TO SCALE	**STANDARD DETAIL**	
DATE: 07/30/13	**RESIDENTIAL WATER METER CONNECTION DETAIL - NO FIRE SPRINKLERS**	REV. 3



NOTE:

- INLET BALL VALVE AND PRESSURE REGULATING VALVE MAY BE MOUNTED VERTICALLY IN ORDER TO MAINTAIN THE 4'-0" DISTANCE ABOVE THE FLOOR
- METER MUST BE MOUNTED IN THE HORIZONTAL POSITION.
- COMMERCIAL METERS SHALL MEET TOWNSHP SPECIFICATIONS
- IT IS THE RESPONSIBILITY OF THE DEVELOPER TO DETERMINE THE SIZE OF THE INTERNAL LINES
- PIPING WILL BE INDEPENDENTLY SUPPORT (FLOOR OR WALL) TO ALLOW FOR METER REMOVAL

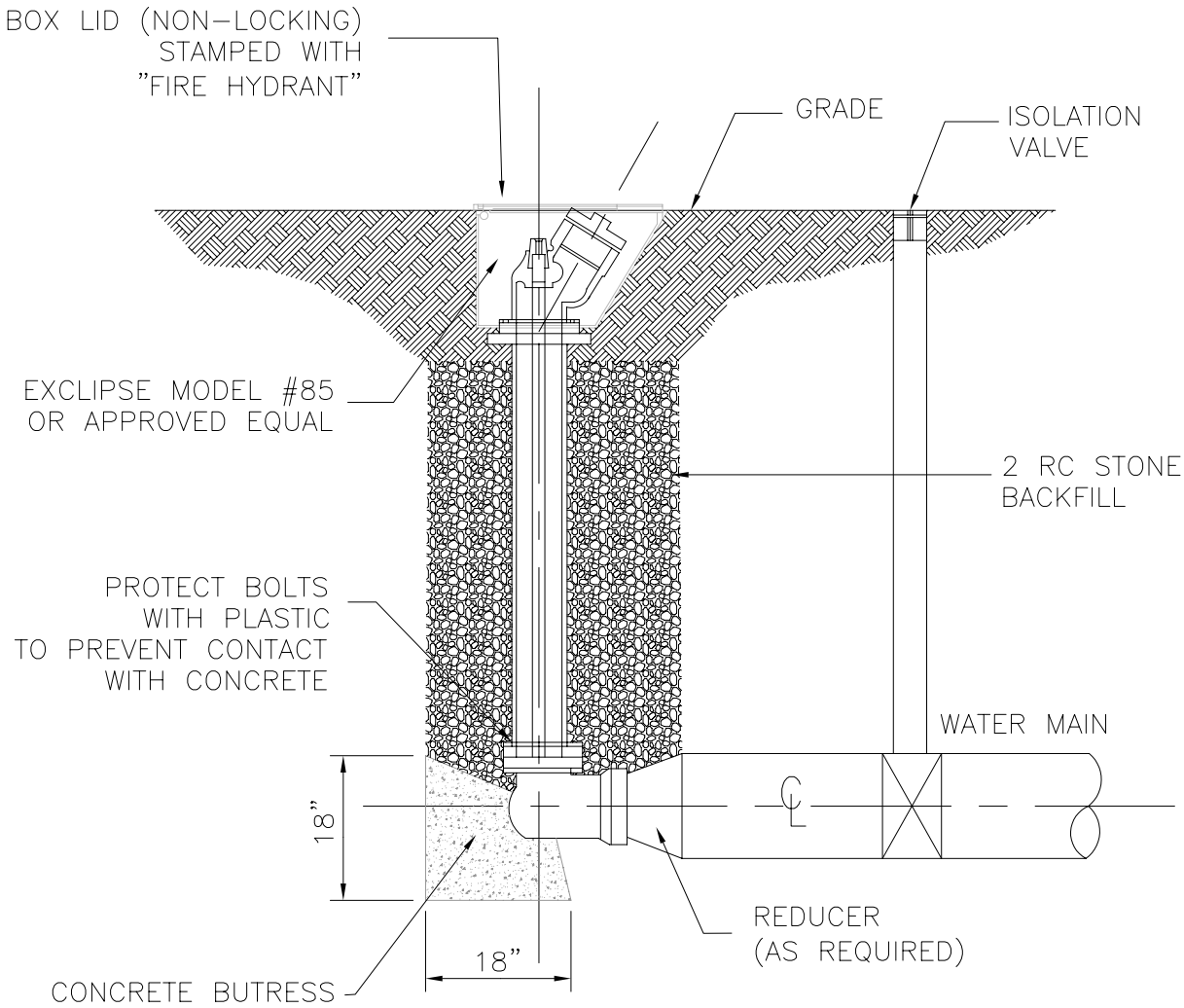
CASTLE VALLEY CONSULTANTS	**BUCKINGHAM TOWNSHIP**	**G-05**
SCALE: NOT TO SCALE	**STANDARD DETAIL**	
DATE: 07/30/04	**COMMERCIAL WATER METER CONN. DETAIL w/ FIRE SPRINKLERS**	REV. 1



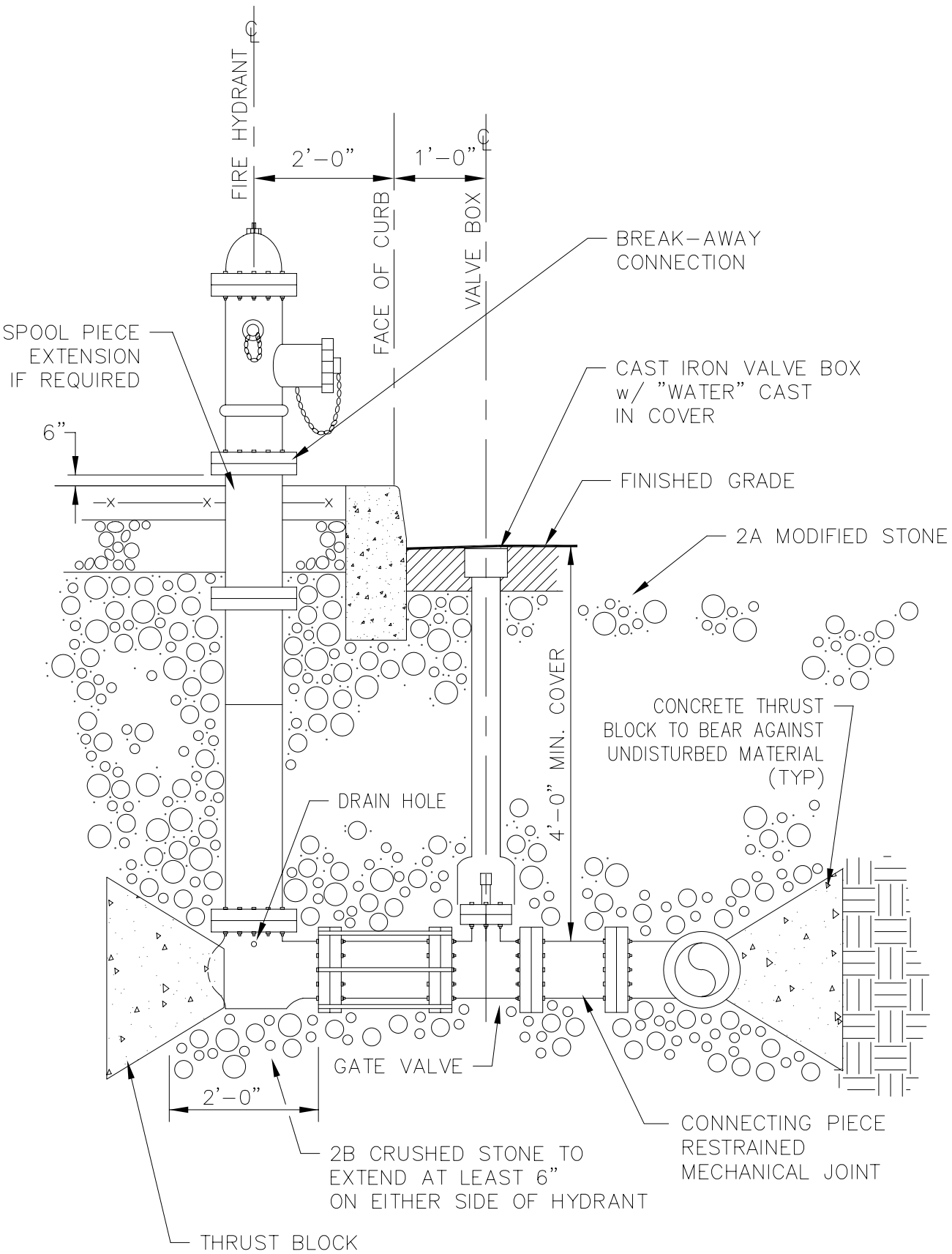
NOTE:

- INLET BALL VALVE AND PRESSURE REGULATING VALVE MAY BE MOUNTED VERTICALLY IN ORDER TO MAINTAIN THE 4'-0" DISTANCE ABOVE FLOOR.
- METER MUST BE MOUNTED IN THE HORIZONTAL POSITION.
- COMMERCIAL METERS SHALL MEET TOWNSHP SPECIFICATIONS
- PIPING SHALL BE INDEPENDENTLY SUPPORTED FROM METER (WALL OR FLOOR) TO ALLOW METER REMOVAL WITH OUT DISTURBING PIPE

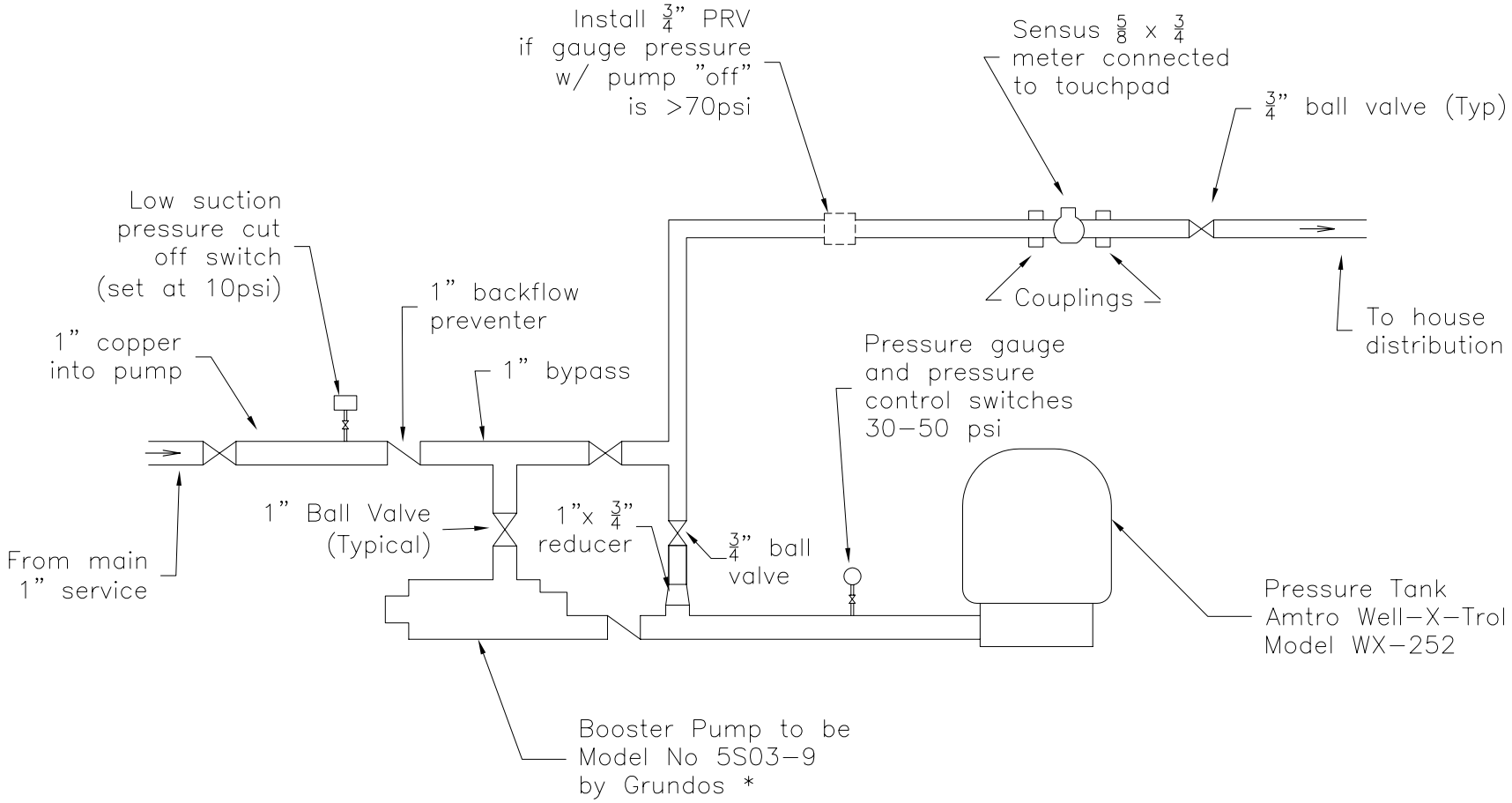
CASTLE VALLEY CONSULTANTS	**BUCKINGHAM TOWNSHIP**	**G-06**
SCALE: NOT TO SCALE	**STANDARD DETAIL**	
DATE: 07/30/04	**COMMERCIAL WATER METER CONNECTION DETAIL**	REV. 1



CASTLE VALLEY CONSULTANTS	**BUCKINGHAM TOWNSHIP**	**G-07**
SCALE: NOT TO SCALE	**STANDARD DETAIL**	
DATE: 07/30/04	**BLOW OFF DETAIL**	REV. 0



CASTLE VALLEY CONSULTANTS	**BUCKINGHAM TOWNSHIP**	**G-08**
SCALE: NOT TO SCALE	**STANDARD DETAIL**	
DATE: 07/30/04	**FIRE HYDRANT LOCATION DETAIL**	REV. 0



* Acceptable alternate: Amtrol RP–15 system.

Supply (1) re–build kit for pump seals.

CASTLE VALLEY CONSULTANTS

SCALE: NOT TO SCALE

DATE: 07/30/04

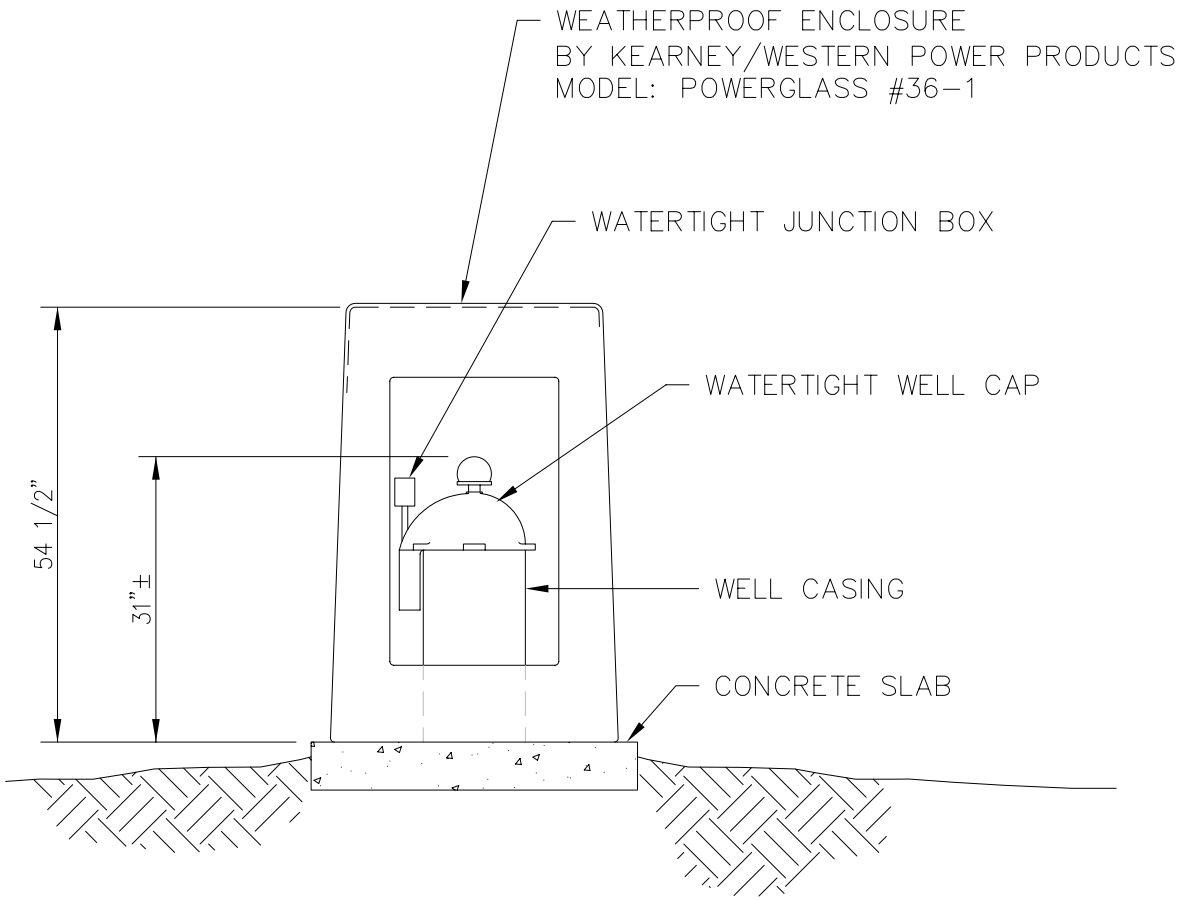
BUCKINGHAM TOWNSHIP

STANDARD DETAIL

RESIDENTIAL BOOSTER PUMP

G-09

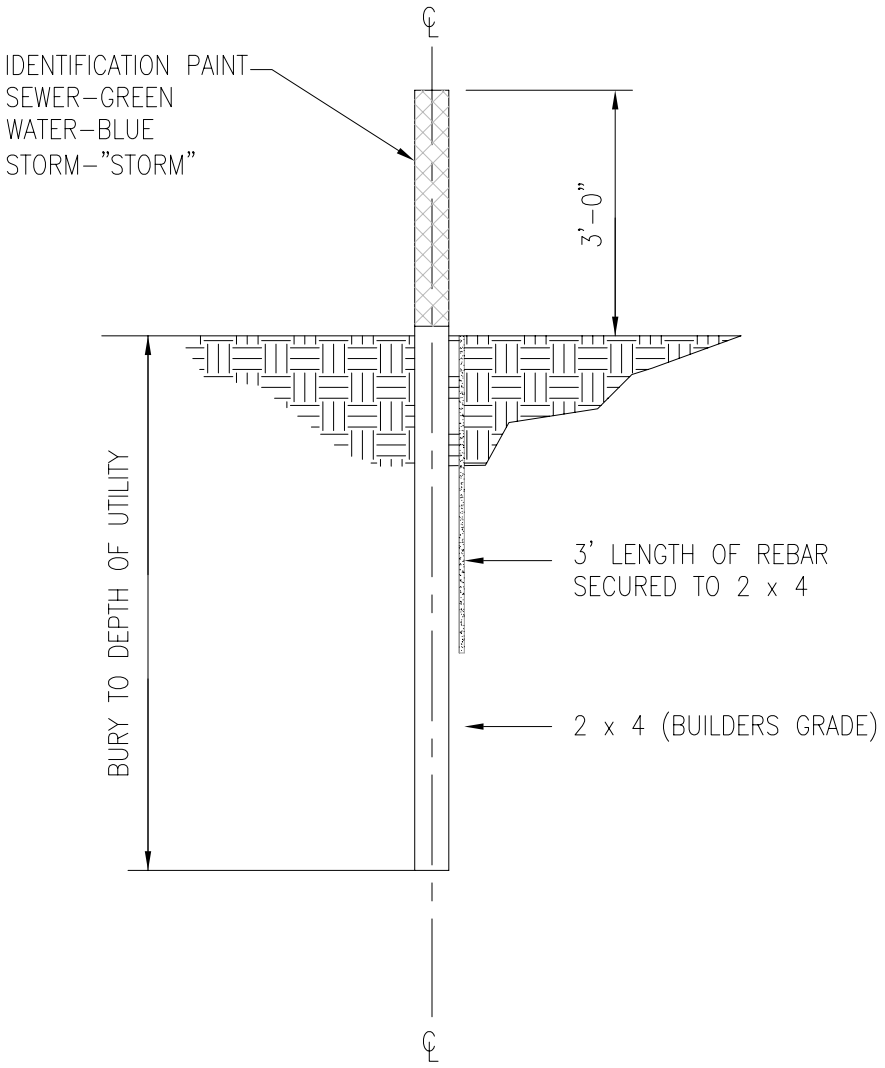
REV. 0



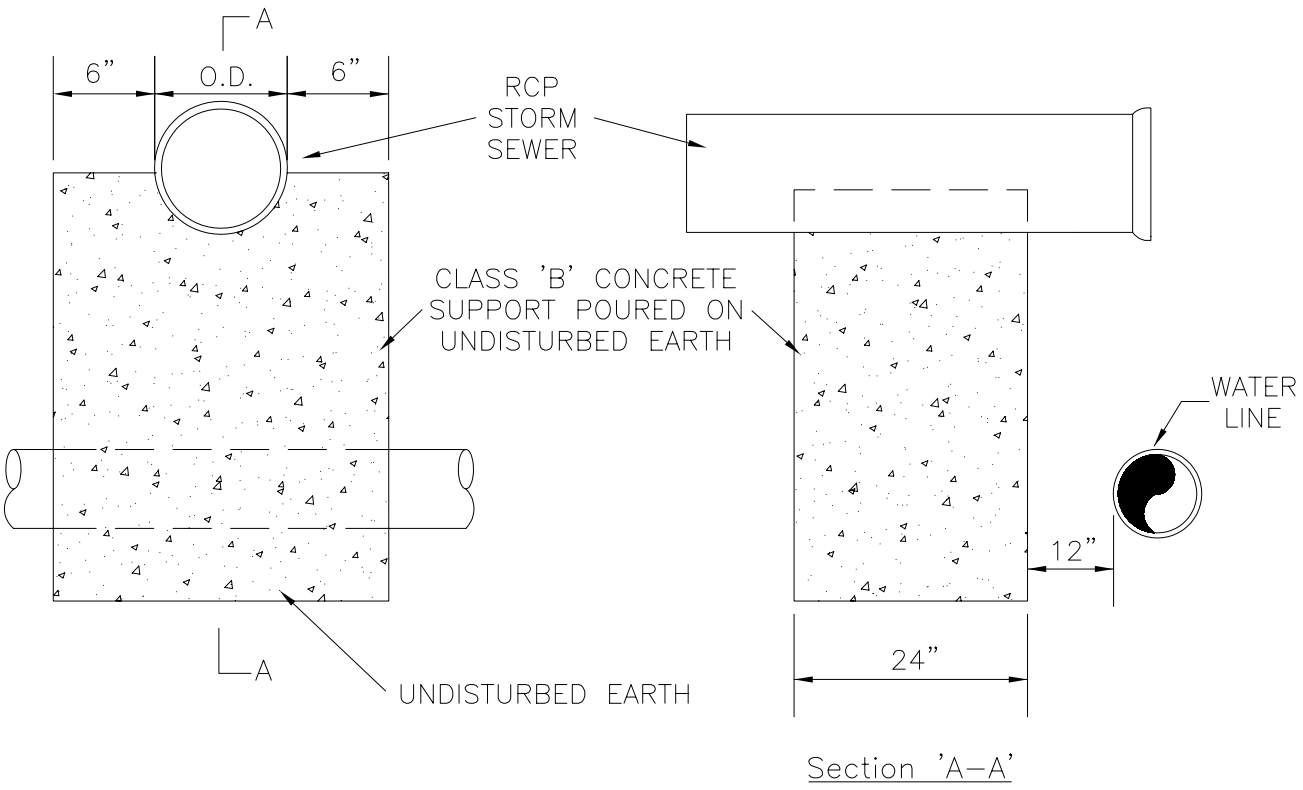
NOTES:

1.
2.

CASTLE VALLEY CONSULTANTS	**BUCKINGHAM TOWNSHIP**	**G-10**
SCALE: NOT TO SCALE	**STANDARD DETAIL**	
DATE: 07/30/04	**PRODUCTION WELL ENCLOSURE DETAIL**	REV. 0



CASTLE VALLEY CONSULTANTS	**BUCKINGHAM TOWNSHIP**	**G–11**
SCALE: NOT TO SCALE	**STANDARD DETAIL**	
DATE: 07/30/04	**UNDERGROUND UTILITY MARKER DETAIL**	REV. 0

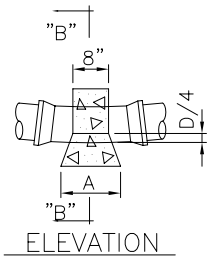


Section 'A–A'

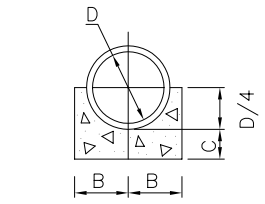
NOTES.

1. STORM SEWER SUPPORT TO BE INSTALLED WHEREVER WATER LINES CROSS BELOW STORM SEWER WITH LESS THAN 18" CLEARANCE
2. STORM SEWER SUPPORT TO BE INSTALLEDINT HE MIDDLE OF A SINGLE SECTION OF THE RCP STORM SEWER PIPE IN QUESTION.

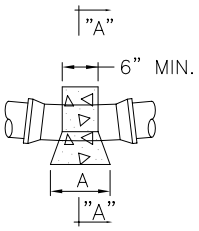
CASTLE VALLEY CONSULTANTS	**BUCKINGHAM TOWNSHIP**	**G-12**
SCALE: NOT TO SCALE	**STANDARD DETAIL**	
DATE: 07/30/04	**STORM SEWER SUPPORT DETAIL**	REV. 0



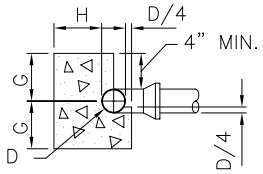
ELEVATION



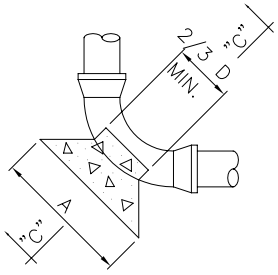
SECTION "B–B"



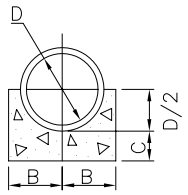
PLAN



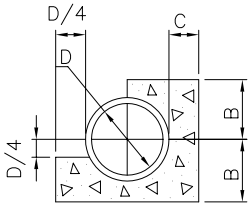
SECTION "D–D"



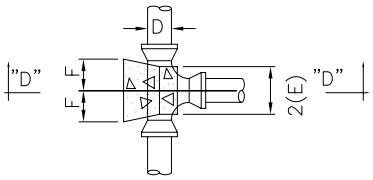
ELEVATION



SECTION "C–C"



SECTION "A–A"



PLAN

BUTTRESS FOR HORIZONTAL BENDS					
BEND	D	4"	5"	6"	8"
1/32	A	6"	6"	6"	8"
	B	7"	7"	7"	8"
	C	7"	7"	7"	7"
1/16	A	9"	9"	9"	12"
	B	7"	7"	7"	8"
	C	8"	8"	8"	9"
1/8	A	15"	15"	15"	20"
	B	7"	7"	7"	8"
	C	8"	8"	8"	9"
1/4	A	24"	24"	24"	30"
	B	6"	6"	6"	9"
	C	10"	10"	10"	12"

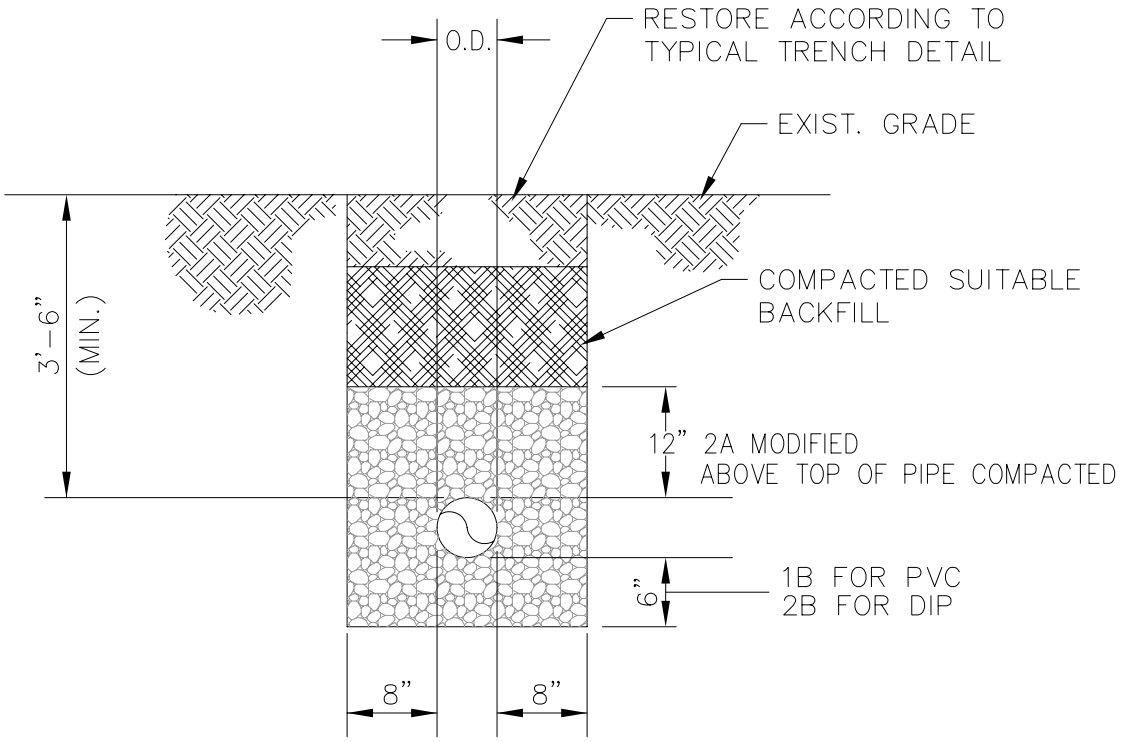
BUTTRESS FOR VERTICAL BENDS					
BEND	D	4"	5"	6"	8"
1/16	A	9"	9"	9"	12"
	B	7"	7"	7"	7"
	C	7"	7"	7"	7"
1/8	A	15"	15"	15"	20"
	B	7"	7"	7"	8"
	C	7"	7"	7"	8"
1/4	A	15"	15"	15"	20"
	B	7"	7"	7"	8"
	C	7"	7"	7"	8"

TEE BUTRESS				
D	4"	5"	6"	8"
E	6"	6"	6"	8"
F	6"	6"	6"	8"
G	8"	8"	8"	10"
H	8"	8"	8"	9"

NOTE:

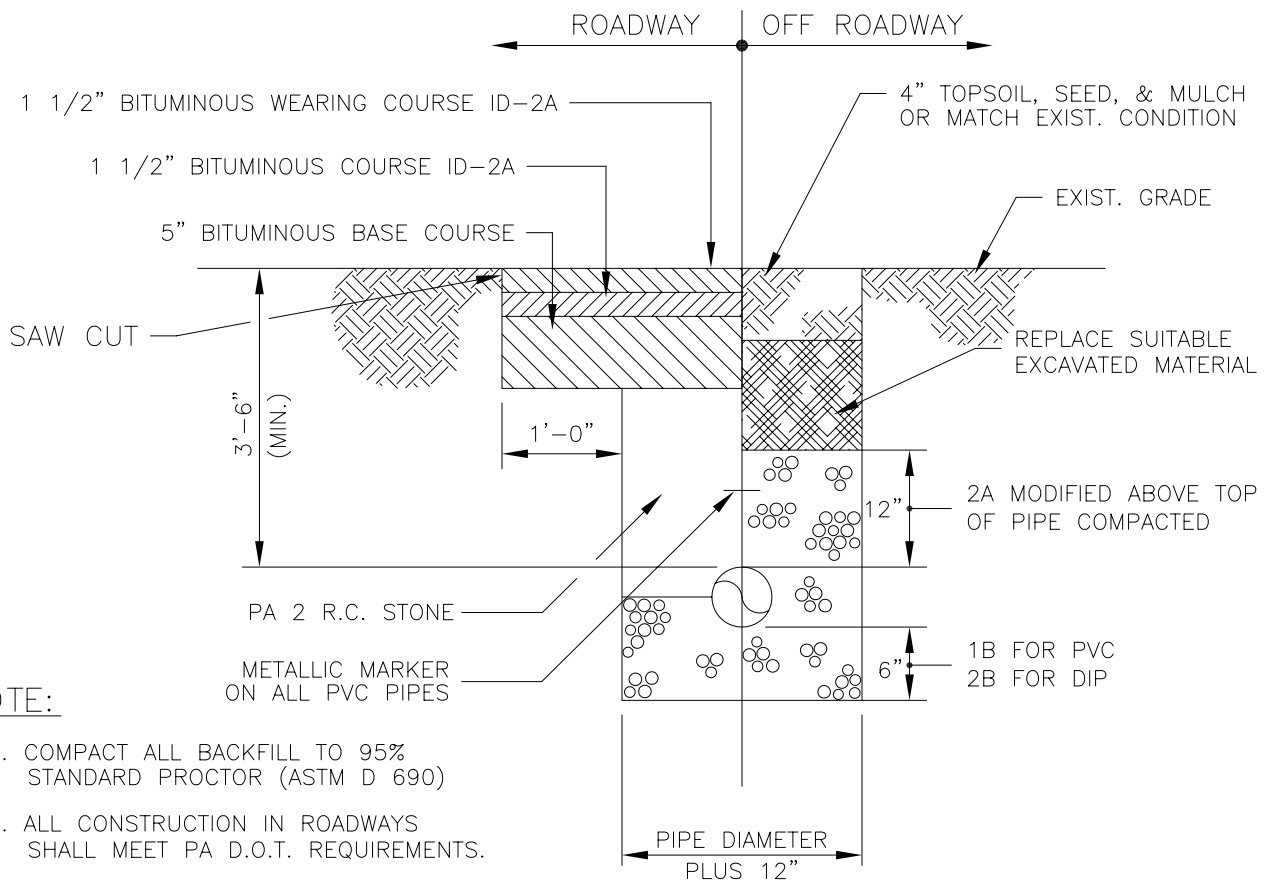
1. DIMENSIONS FOR 4" PIPE IS TYPICAL FOR ALL PRESSURE PIPE SMALLER THAN 4".
2. ALL CONCRETE TO BE 2500 P.S.I.
3. BUTTRESS DIMENSIONS SHOWN ARE MINIMUM DIMENSIONS, BASED UPON SOIL BEARING PRESSURE OF 3000 P.S.F., AND STATIC WATER PRESSURE OF 150 P.S.I. OR WHERE SOIL BEARING PRESSURE IS LESS THAN 3000 P.S.F. SPECIAL BUTTRESS DESIGN IS REQUIRED.
4. COST OF BUTTRESS TO BE INCLUDED IN PRICES BID.
5. MINOR VARIATION IN BUTTRESS SHAPE WILL BE PERMITTED PROVIDED THE MINIMUM BEARING AGAINST SOLID GROUND IS MAINTAINED.
6. CARRY CONCRETE TO UNDISTURBED EARTH.

CASTLE VALLEY CONSULTANTS	**BUCKINGHAM TOWNSHIP**	**G–13**
SCALE: NOT TO SCALE	**STANDARD DETAIL**	
DATE: 07/30/04	**BUTTRESS DETAILS**	REV. 0



NOTE:
SPECIAL CARE SHALL BE TAKEN BY CONTRACTOR
TO PLACE STONE UNDER PIPE.

CASTLE VALLEY CONSULTANTS	**BUCKINGHAM TOWNSHIP**	**G-14**
SCALE: NOT TO SCALE	**STANDARD DETAIL**	
DATE: 05/12/03	**PIPE BEDDING DETAIL**	REV. 0



NOTE:

1. COMPACT ALL BACKFILL TO 95% STANDARD PROCTOR (ASTM D 690)
2. ALL CONSTRUCTION IN ROADWAYS SHALL MEET PA D.O.T. REQUIREMENTS.

TRENCH BACKFILL FOR PIPES:

A. IT IS INTENDED THAT THE MATERIAL EXCAVATED FROM THE TRENCH BE USED FOR TRENCH BACKFILL.

B. ALL BACKFILL OVER PIPES SHALL BE DEVOID OF STONES LARGER THAN 2" IN ANY DIMENSION, LARGE DEBRIS, TRASH, WOOD OR OTHER SIMILAR MATERIALS.

C. AFTER THE PIPE HAS BEEN INSTALLED ON A FIRM FOUNDATION, BACKFILL SHALL BE CAREFULLY PLACED AND CONSOLIDATED UNDER THE PIPE HAUNCH TO PROVIDE ADEQUATE SIDE SUPPORT. THE HAUNCHING BACKFILL SHALL BE PLACED TO THE LEVEL OF THE SPRING LINE OF THE PIPE. THIS MATERIAL SHALL BE PLACED IN SUCH A MANNER AS NOT TO DISTURB THE PIPELINES. THIS EARTH SHALL BE TAMPED WITH A NON-MECHANICAL TAMPER.

D. A LAYER OR INITIAL BACKFILL SHALL BE HAND PLACED ABOVE THE SPRING LINE OF THE PIPE UNTIL A PROTECTIVE CUSHION OF 6" OF COVER OVER THE PIPE IS REACHED. THE INITIAL BACKFILL SHALL NOT BE TAMPED AFTER PLACEMENT.

E. THE REMAINDER OF THE TRENCH SHALL BE BACKFILLED IN UNIFORM LAYERS NOT MORE THAN 12" THICK AND COMPACTED TO ACHIEVE 85% MODIFIED PROCTOR DENSITY. THE MOISTURE CONTENT OF THE MATERIAL BEING COMPACTED SHALL BE WITHIN ±3 PERCENTAGE POINTS OF OPTIMUM DETERMINED BY AASHO DESIGNATION T-99. MATERIAL CONTAINING AN EXCESS OF MOISTURE CONTENT IS WITHIN THIS SPECIFIED RANGE. FILL MATERIAL WHICH IS TOO DRY TO BE COMPACTED SHALL BE WETTED.

F. REFILL IN ALL EXCAVATIONS SHALL BE RESTORED TO THE CONDITION THAT EXISTED PRIOR TO BEGINNING WORK.

CASTLE VALLEY CONSULTANTS	**BUCKINGHAM TOWNSHIP**	**G-15**
SCALE: NOT TO SCALE	**STANDARD DETAIL**	
DATE: 07/30/04	**TRENCH / ROAD RESTORATION DETAIL**	REV. 0

CASTLE VALLEY CONSULTANTS

SCALE: NOT TO SCALE

DATE: 07/30/04

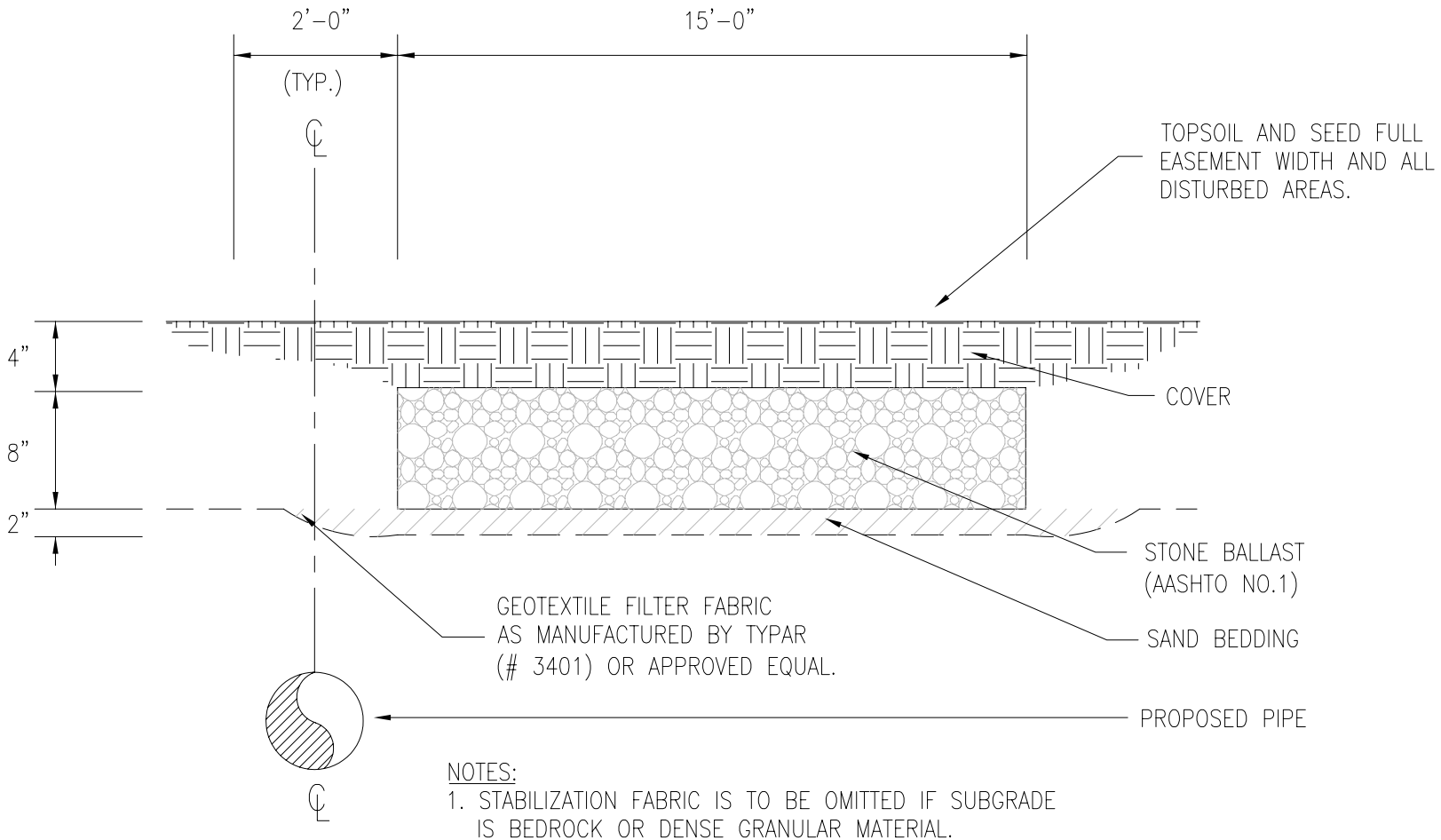
BUCKINGHAM TOWNSHIP

STANDARD DETAIL

STABILIZED ACCESS BED DETAIL

G-15a

REV. 0



NOTES:

1. STABILIZATION FABRIC IS TO BE OMITTED IF SUBGRADE IS BEDROCK OR DENSE GRANULAR MATERIAL.
2. SURVEYOR'S MARKERS TO BE PLACED IN 100' C.C. BOTH SIDES OF THE 15' BASE MARKER TO BE FLUSH WITH FINISHED GRADE.

CASTLE VALLEY CONSULTANTS

SCALE: NOT TO SCALE

DATE: 07/30/04

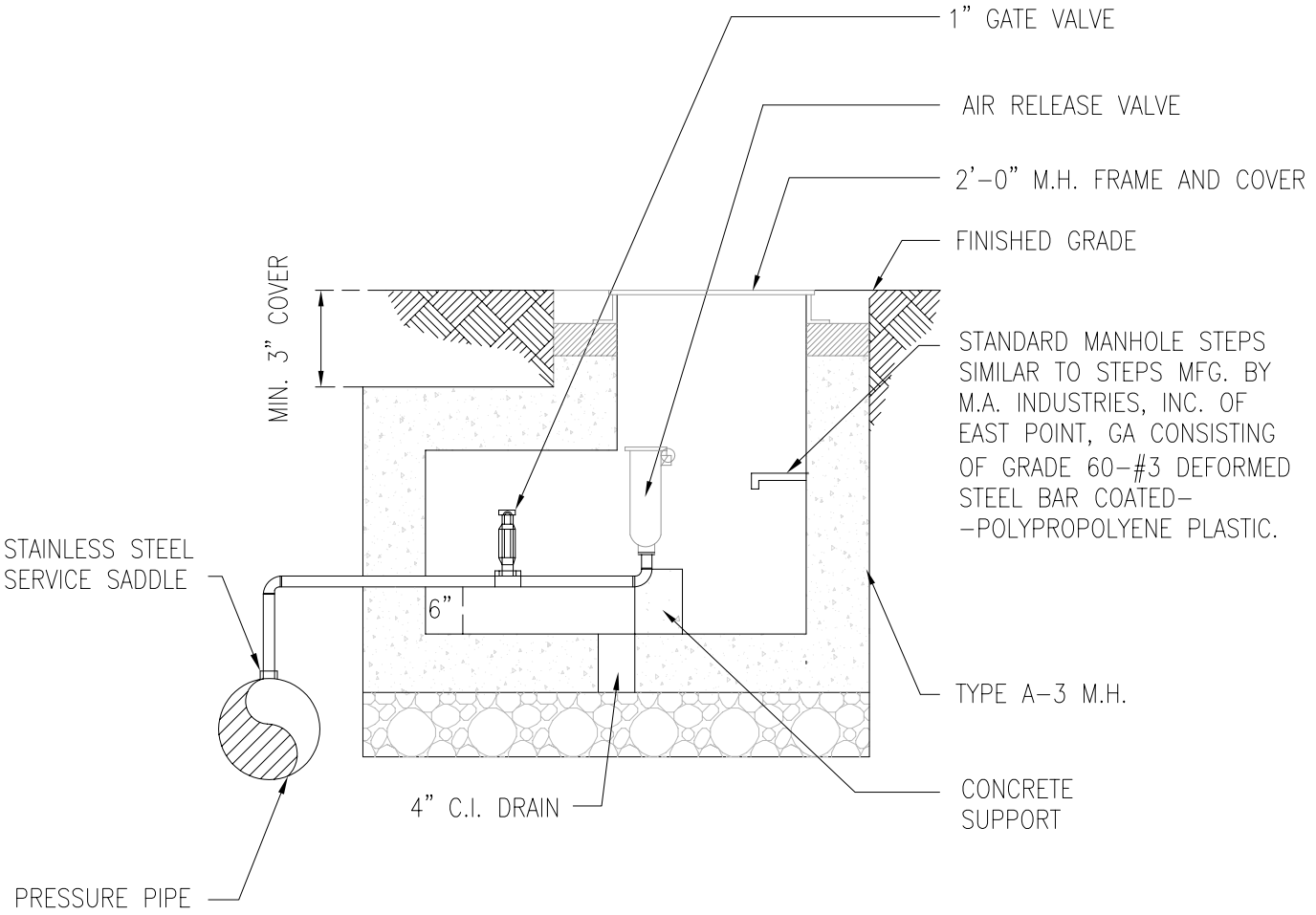
BUCKINGHAM TOWNSHIP

STANDARD DETAIL

AUTOMATIC AIR RELEASE VALVE DETAIL (SIDE INSTALLATION)

G-16

REV. 0



NOTE:

1. ALL PIPE, FITTINGS, AND NIPPLES SHALL BE H.D. PVC.

CASTLE VALLEY CONSULTANTS

SCALE: NOT TO SCALE

DATE: 07/30/04

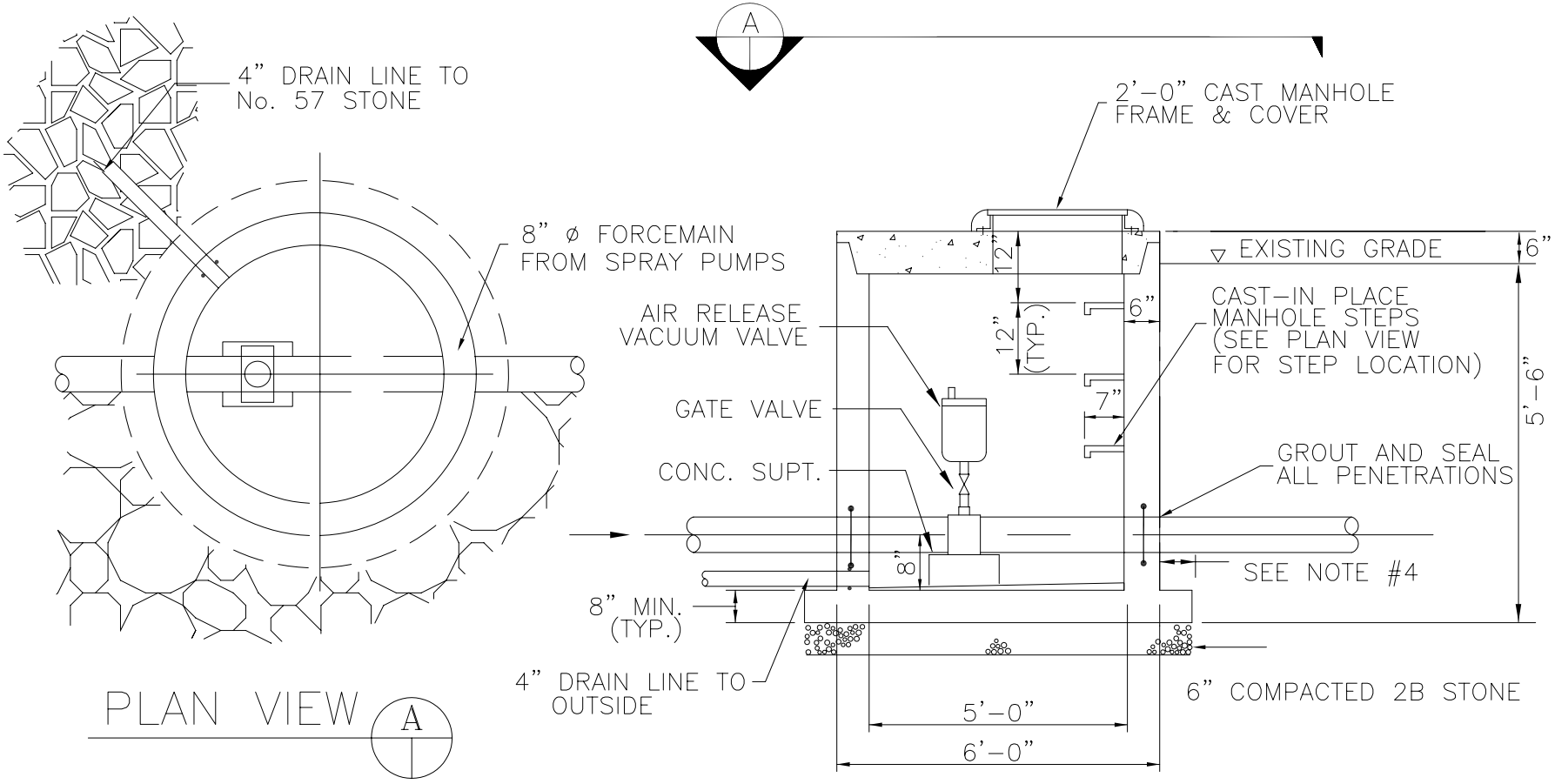
BUCKINGHAM TOWNSHIP

STANDARD DETAIL

AIR RELEASE MANHOLE DETAIL (IN-LINE INSTALLATION)

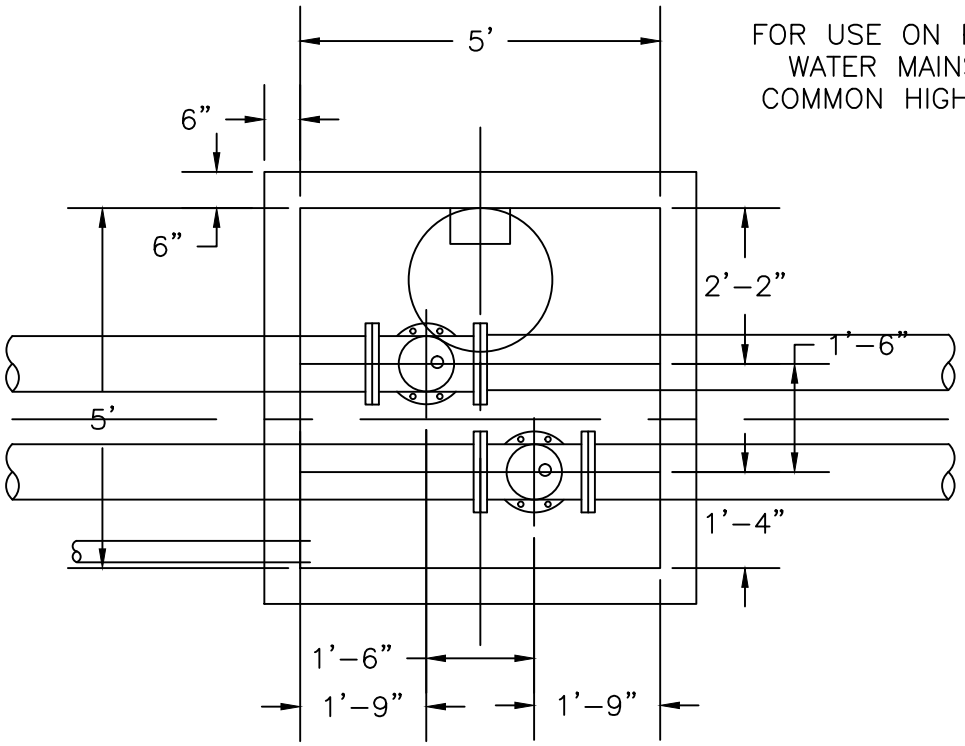
G-17

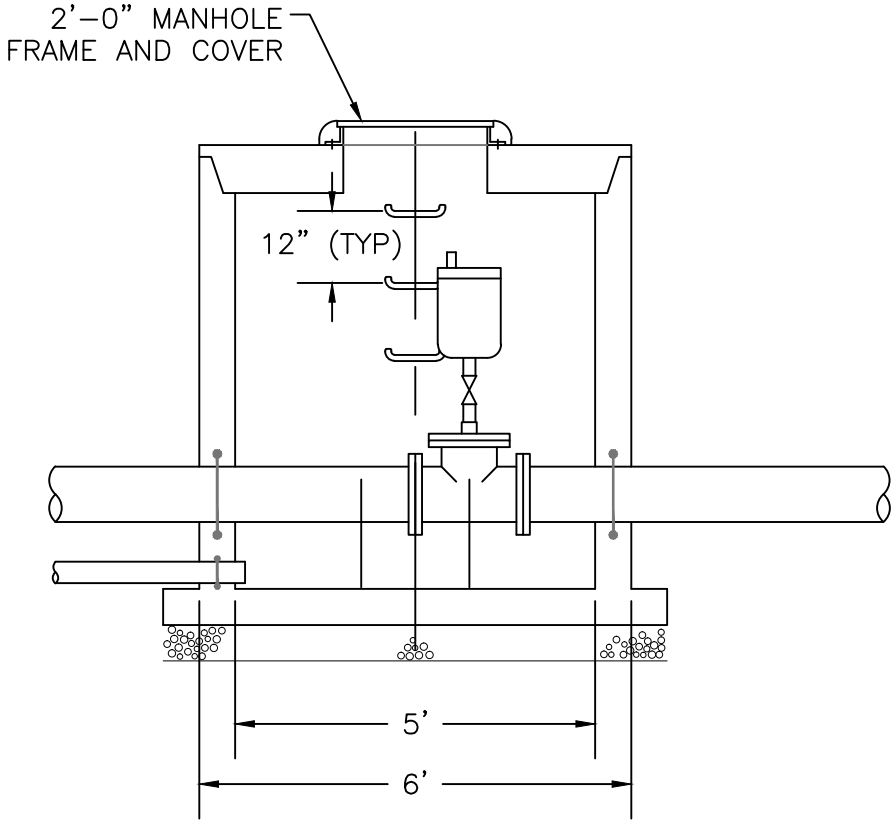
REV. 0



NOTES:

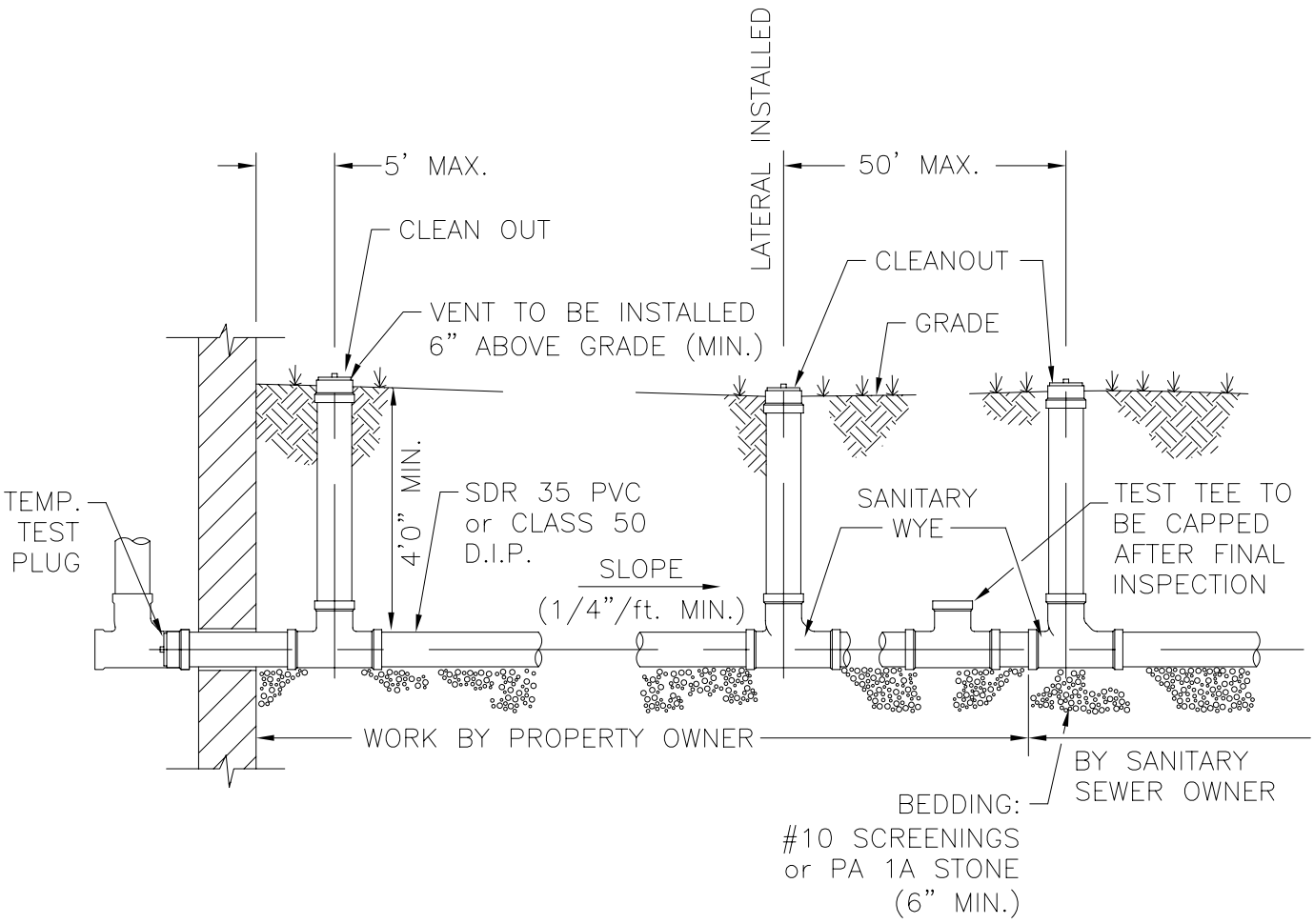
1. SEE PRECAST DESIGN REQUIREMENTS.
2. ALL PIPE PENETRATIONS SHALL HAVE INTEGRALLY CAST RUBBER GASKET MEETING ASTM C-443.
3. ALL FIELD PIPE PENETRATIONS SHALL BE SEALED WITH NON-SHRINK GROUT.
4. ANTI-FLOTATION RINGS IN ACCORDANCE WITH PRECAST CONCRETE STRUCTURAL DESIGN REQUIREMENTS.

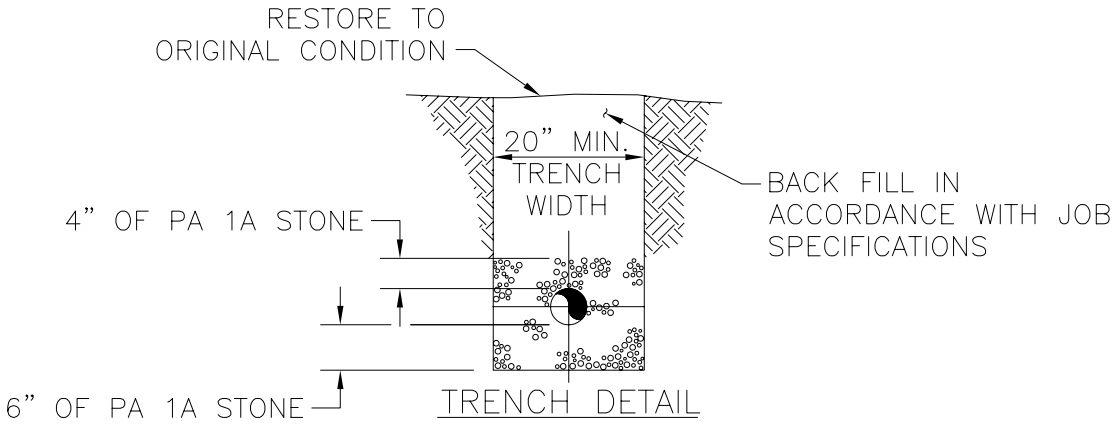




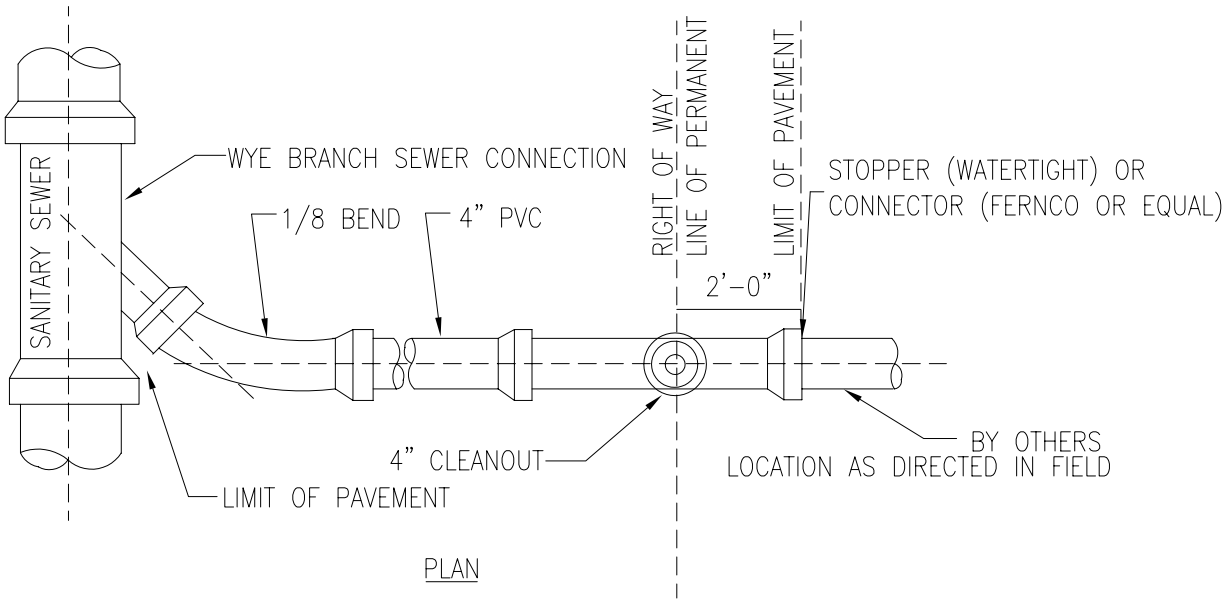
FILE LOCATION: I:\DETAILS\TWP STANDARDS\BUCKINGHAM\G-17B DBL ARV DETAIL

CASTLE VALLEY CONSULTANTS	**BUCKINGHAM TOWNSHIP**	**G-17B**
SCALE: NOT TO SCALE	**STANDARD DETAIL**	
DATE: 06/25/2015	**DUAL AIR RELEASE MANHOLE DETAIL (IN-LINE INSTALLATION)**	REV. 0

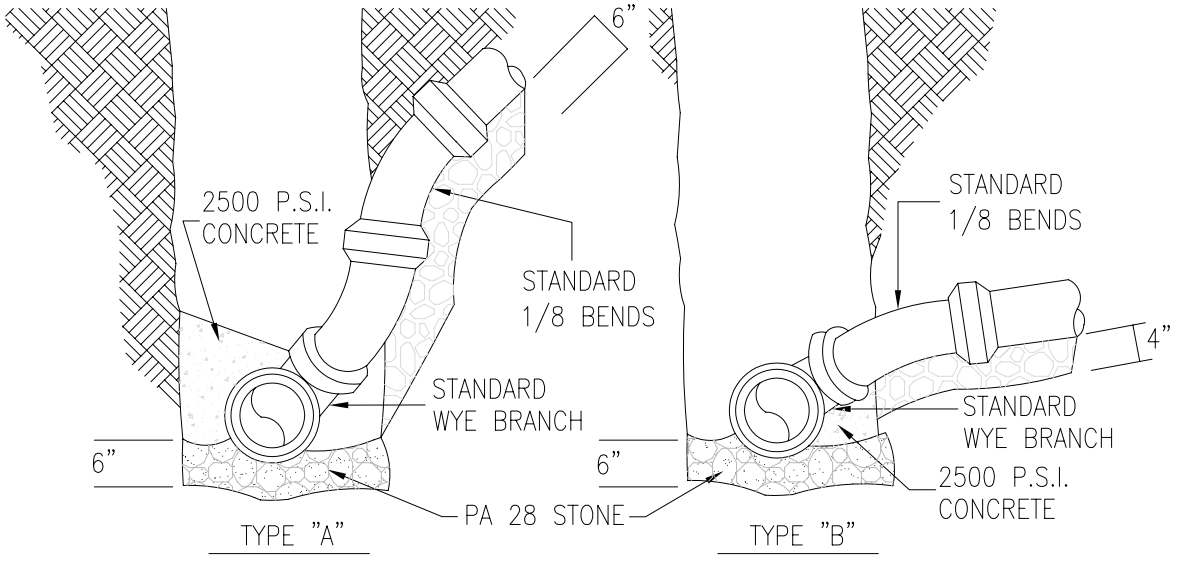




CASTLE VALLEY CONSULTANTS	**BUCKINGHAM TOWNSHIP**	**G-18**
SCALE: NOT TO SCALE	**STANDARD DETAIL**	
DATE: 07/30/04	**BUILDING SEWER DETAIL - AT EXISTING LATERAL STAKE**	REV. 0

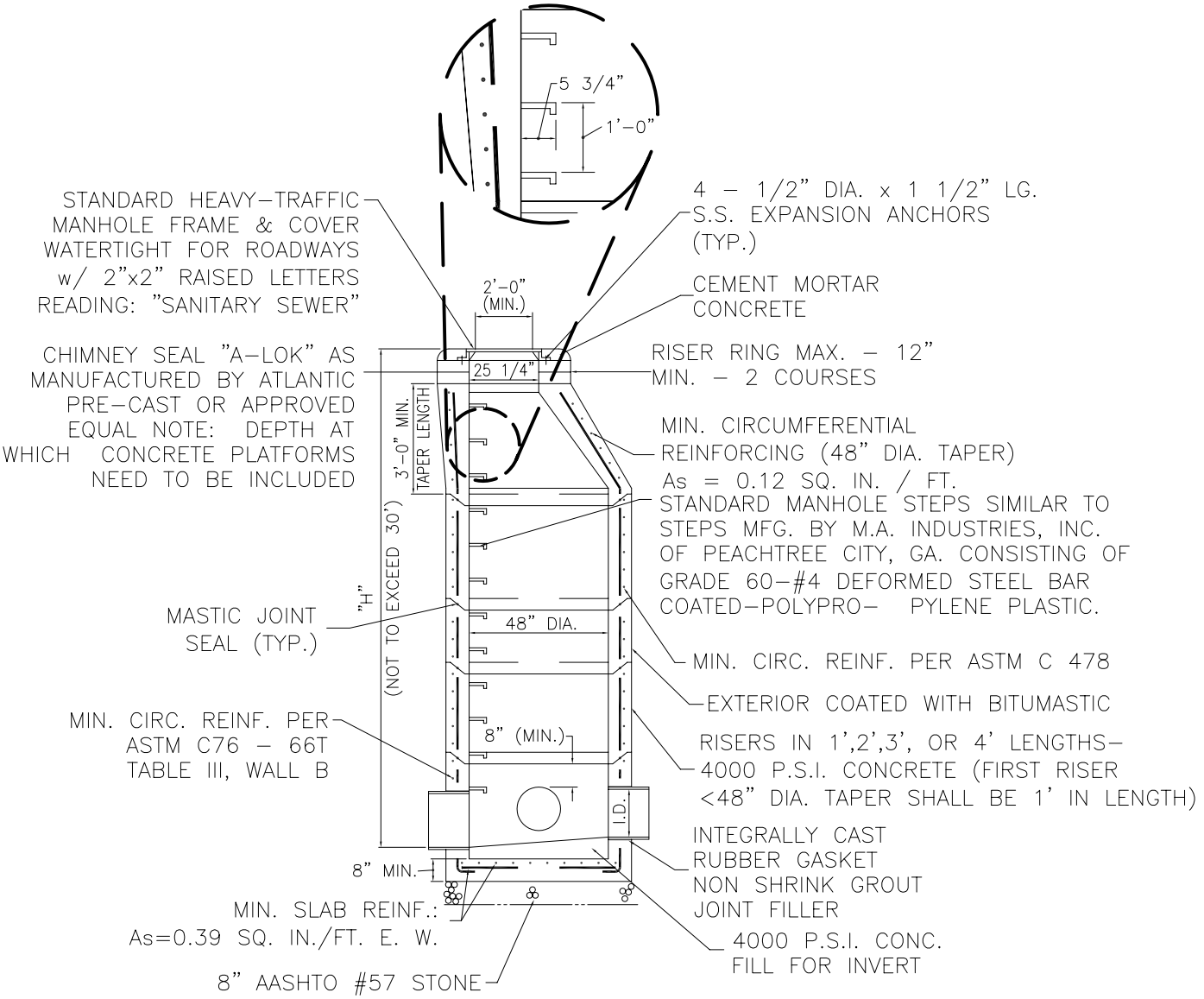


PLAN



SECTION

CASTLE VALLEY CONSULTANTS	**BUCKINGHAM TOWNSHIP**	**G-19**
SCALE: NOT TO SCALE	**STANDARD DETAIL**	
DATE: 07/30/04	**SANITARY SEWER WYE CONNECTION DETAIL**	REV. 0

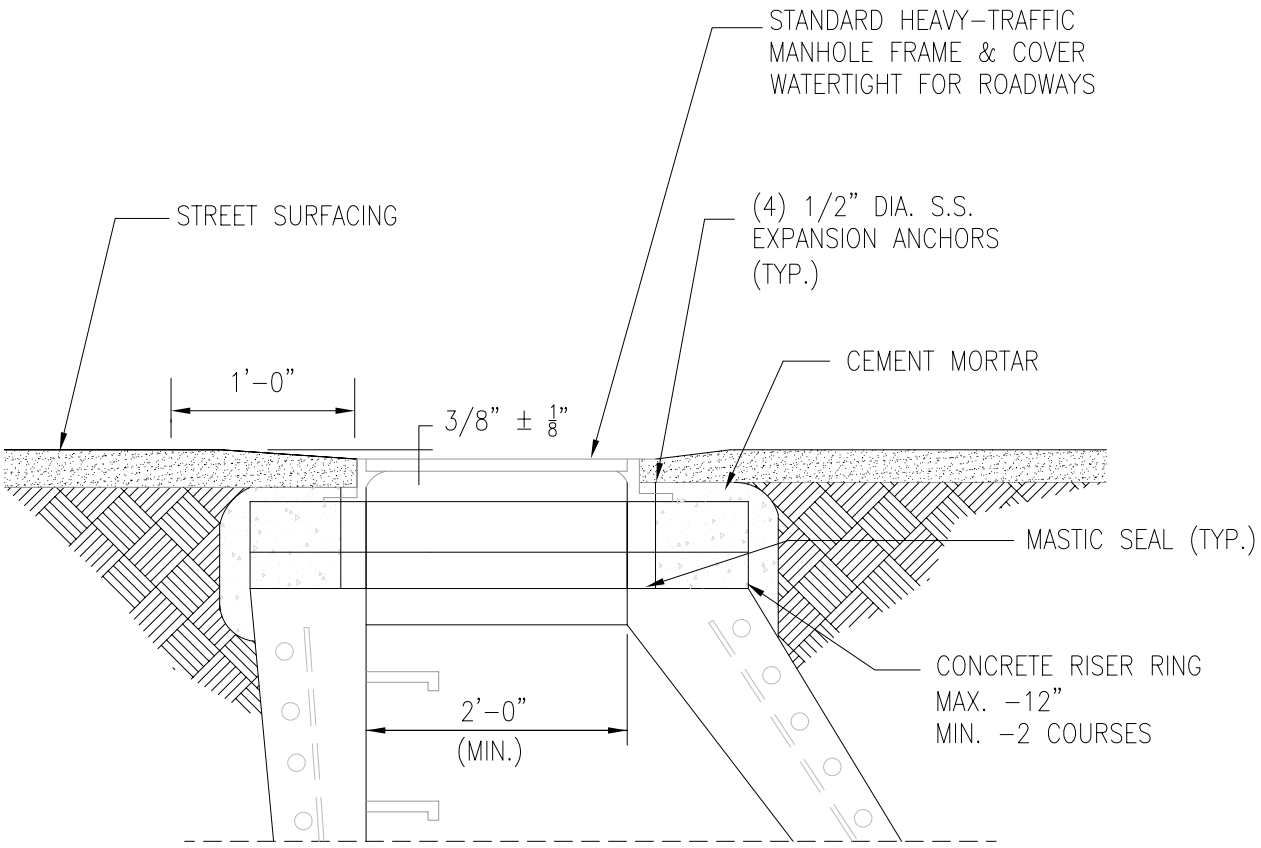


PIPE SIZE	MIN. MH BASE LENGTH	MIN. H FOR A-2 MAX. H FOR A-3
TO 15" DIA.	3'	6.5'
18" TO 24" DIA.	4'	7.5'
27" TO 36" DIA.	5'	8.5'

NOTES:

1. UNLESS OTHERWISE NOTED, MANHOLE TAPERS, RISERS, AND BASES SHALL BE FURNISHED IN STRICT ACCORDANCE WITH ASTM DESIGNATION C478 (LATEST) FOR PRECAST REINFORCED CONCRETE MANHOLES.
2. MANHOLE BASES SHALL BE OF 4,000 P.S.I. PRECAST CONCRETE.
3. REINFORCING FOR TYPE A-3 MANHOLE SAME AS TYPE A-2 MANHOLE, EXCEPT AS NOTED.
4. MANHOLE STEPS SHALL BE SPACED AS SHOWN IN A SINGLE VERTICAL ALIGNMENT. THE STEPS SHALL NOT BE STAGGERED.

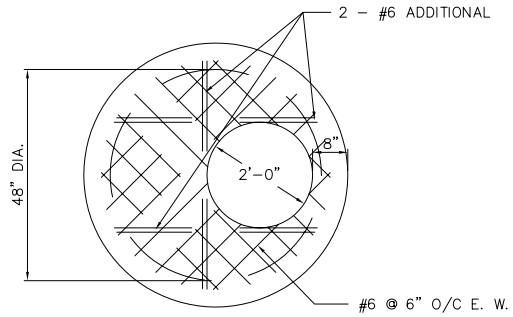
CASTLE VALLEY CONSULTANTS	**BUCKINGHAM TOWNSHIP**	**G-20**
SCALE: NOT TO SCALE	**STANDARD DETAIL**	
DATE: 07/30/04	**48" PRECAST MANHOLE TYPE A-2**	REV. 0



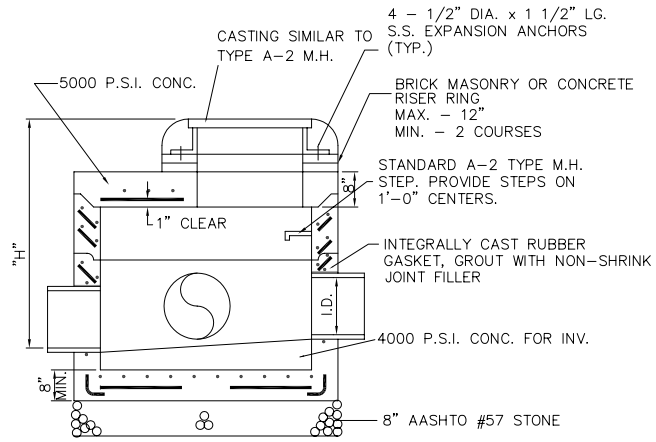
NOTES:

1. ADJUST MANHOLES UPWARD WITH ADJUSTING RINGS UNDER FRAME.
2. ADJUST MANHOLES DOWNWARD BY REMOVING CONE AND BARREL SECTIONS AS NECESSARY AND REPLACING WITH SECTIONS OF LENGTH REQUIRED TO MATCH GRADE.
3. SLOPE MANHOLE FRAME AS REQUIRED TO MATHCH SLOPE OF STREET.
4. FINAL MANHOLE ADJUSTMENT SHALL BE MADE BEFORE FINAL PAVING.

CASTLE VALLEY CONSULTANTS	**BUCKINGHAM TOWNSHIP**	**G–21**
SCALE: NOT TO SCALE	**STANDARD DETAIL**	
DATE: 07/30/04	**MANHOLE COVER FINAL ADJUSTMENT IN ROADWAYS**	REV. 0



SLAB REINFORCING
FOR SHALLOW
PRECAST MANHOLE TYPE A–3

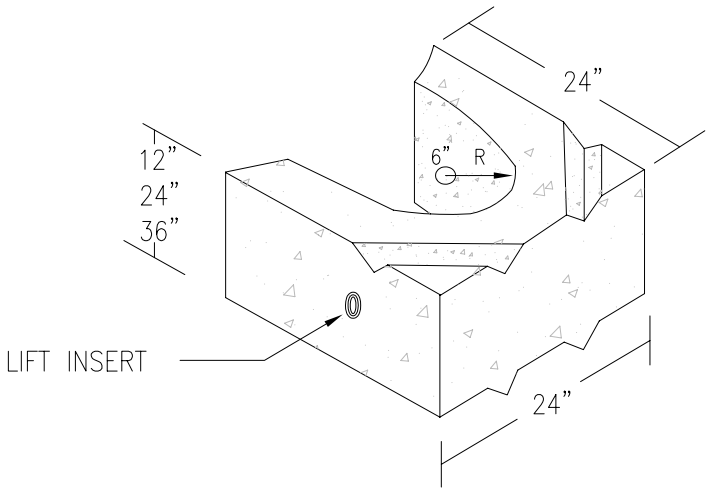


48" SHALLOW PRECAST MANHOLE
TYPE A–3

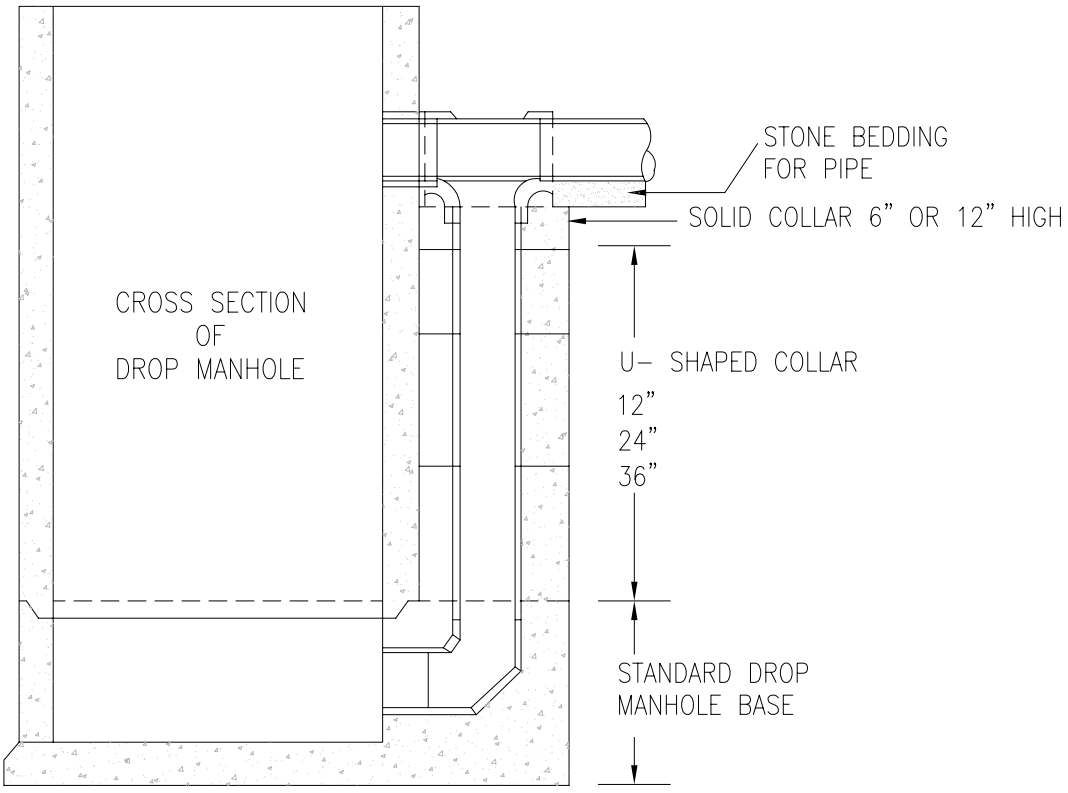
PIPE SIZE	MIN. MH BASE LENGTH	MIN. H FOR A–2 MAX. H FOR A–3
TO 15" DIA.	3'	6.5'
18" TO 24" DIA.	4'	7.5'
27" TO 36" DIA.	5'	8.5'

NOTES:
1. UNLESS OTHERWISE NOTED, MANHOLE TAPERS, RISERS, AND BASES SHALL BE FURNISHED IN STRICT ACCORDANCE WITH ASTM DESIGNATION C478 (LATEST) FOR PRECAST REINFORCED CONCRETE MANHOLES.
2. MANHOLE BASES SHALL BE OF 4,000 P.S.I. PRECAST CONCRETE.
3. REINFORCING FOR TYPE A–3 MANHOLE SAME AS TYPE A–2 MANHOLE, EXCEPT AS NOTED.
4. MANHOLE STEPS SHALL BE SPACED AS SHOWN IN A SINGLE VERTICAL ALIGNMENT. THE STEPS SHALL NOT BE STAGGERED.

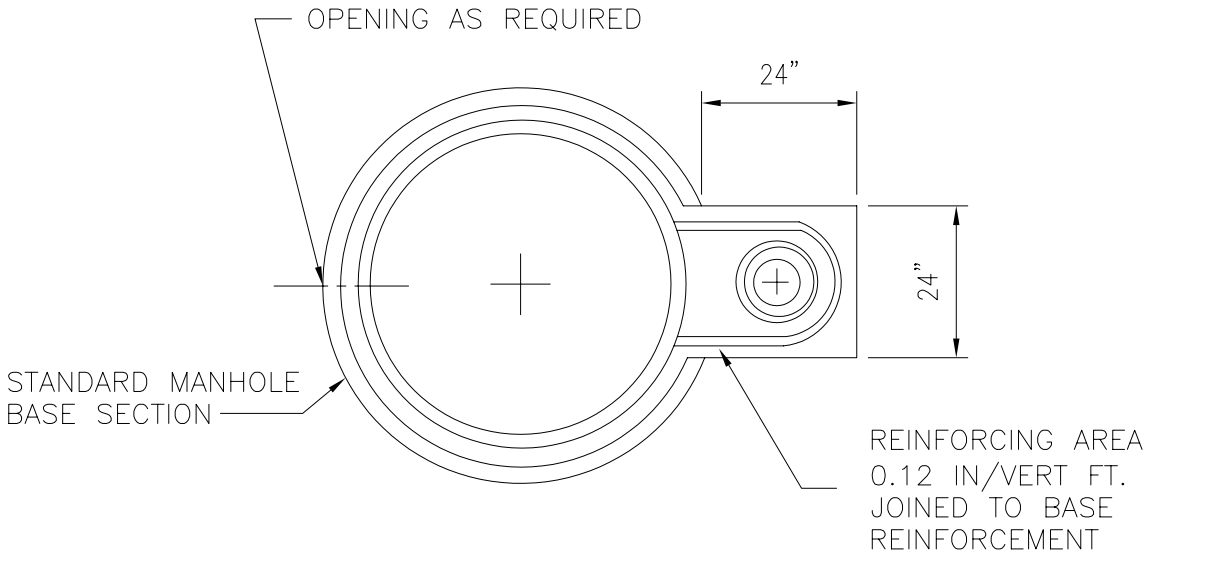
CASTLE VALLEY CONSULTANTS	**BUCKINGHAM TOWNSHIP**	**G–22**
SCALE: NOT TO SCALE	**STANDARD DETAIL**	
DATE: 07/30/04	**48" SHALLOW PRE-CAST MANHOLE DETAIL**	REV. 0

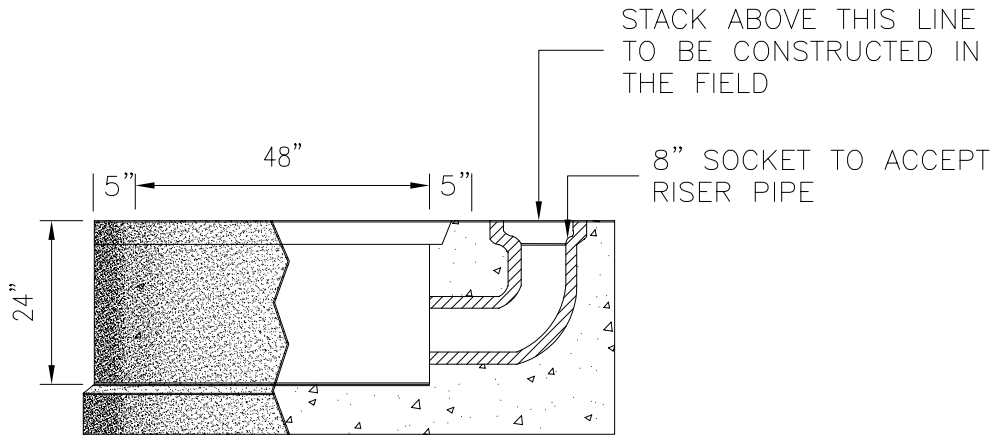


U–SHAPED COLLAR



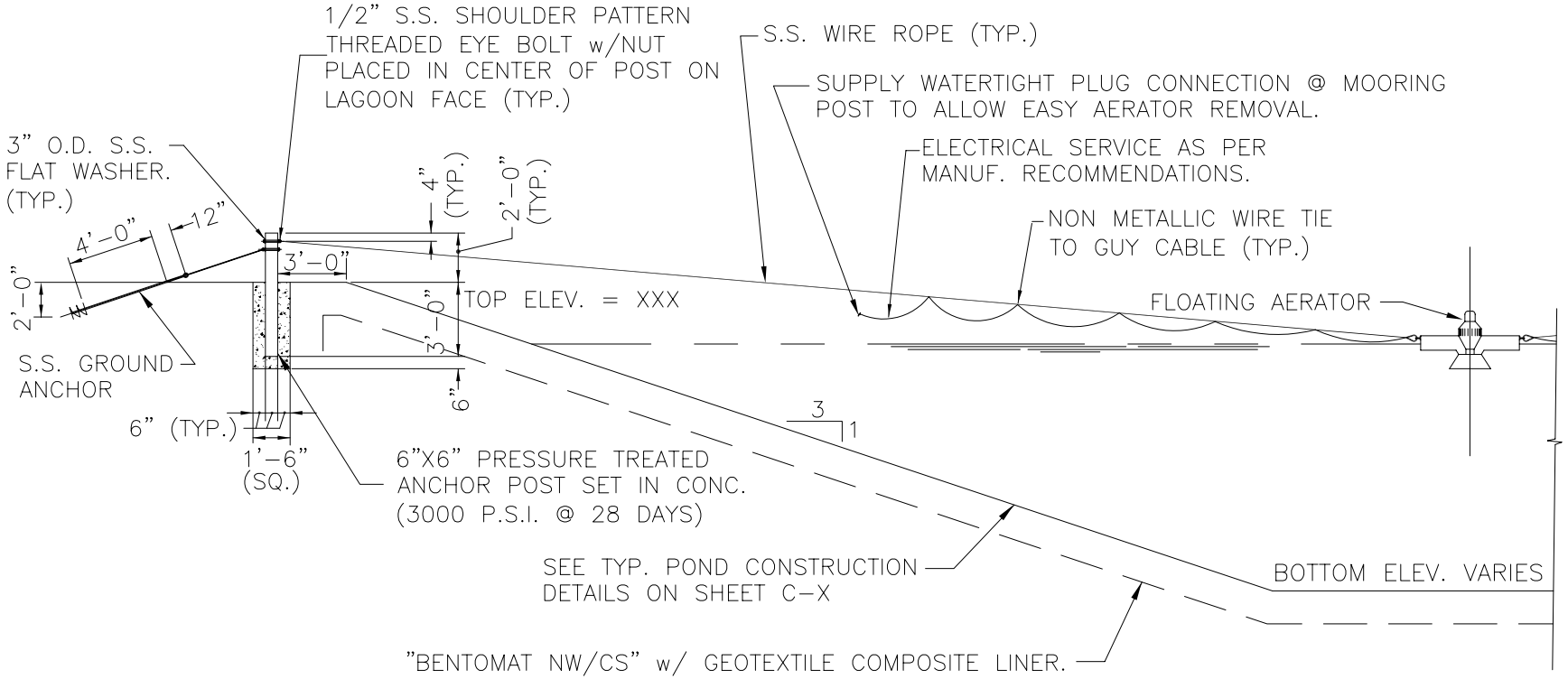
CASTLE VALLEY CONSULTANTS	**BUCKINGHAM TOWNSHIP**	**G–23a**
SCALE: NOT TO SCALE	**STANDARD DETAIL**	
DATE: 07/30/04	**DROP MANHOLE COLLARS**	REV. 0





MANHOLE BASE WITH PRECAST DROP

CASTLE VALLEY CONSULTANTS	**BUCKINGHAM TOWNSHIP**	**G-23b**
SCALE: NOT TO SCALE	**STANDARD DETAIL**	
DATE: 07/30/04	**MANHOLE WITH PRECAST DROP**	REV. 0



CASTLE VALLEY CONSULTANTS

SCALE: NOT TO SCALE

DATE: 07/30/04

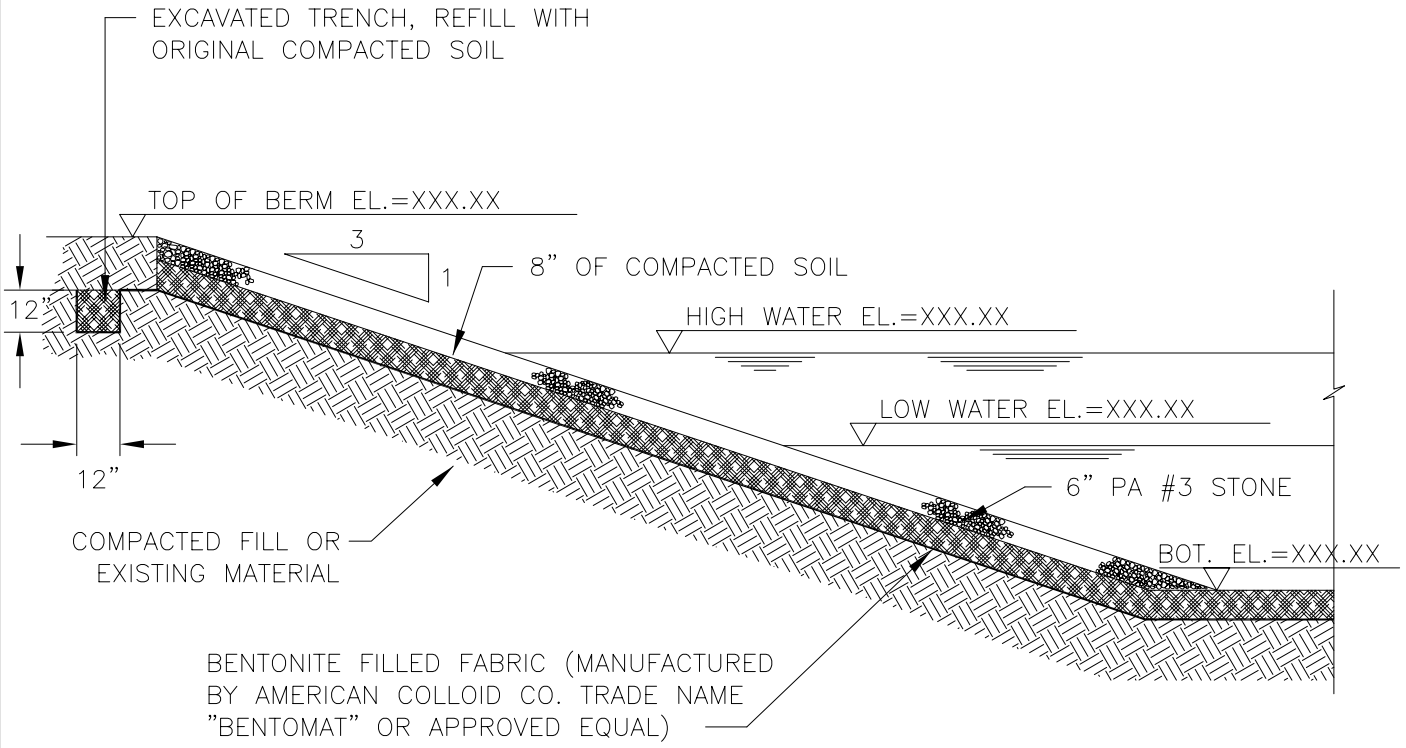
BUCKINGHAM TOWNSHIP

STANDARD DETAIL

AERATOR MOORING DETAIL

G-24

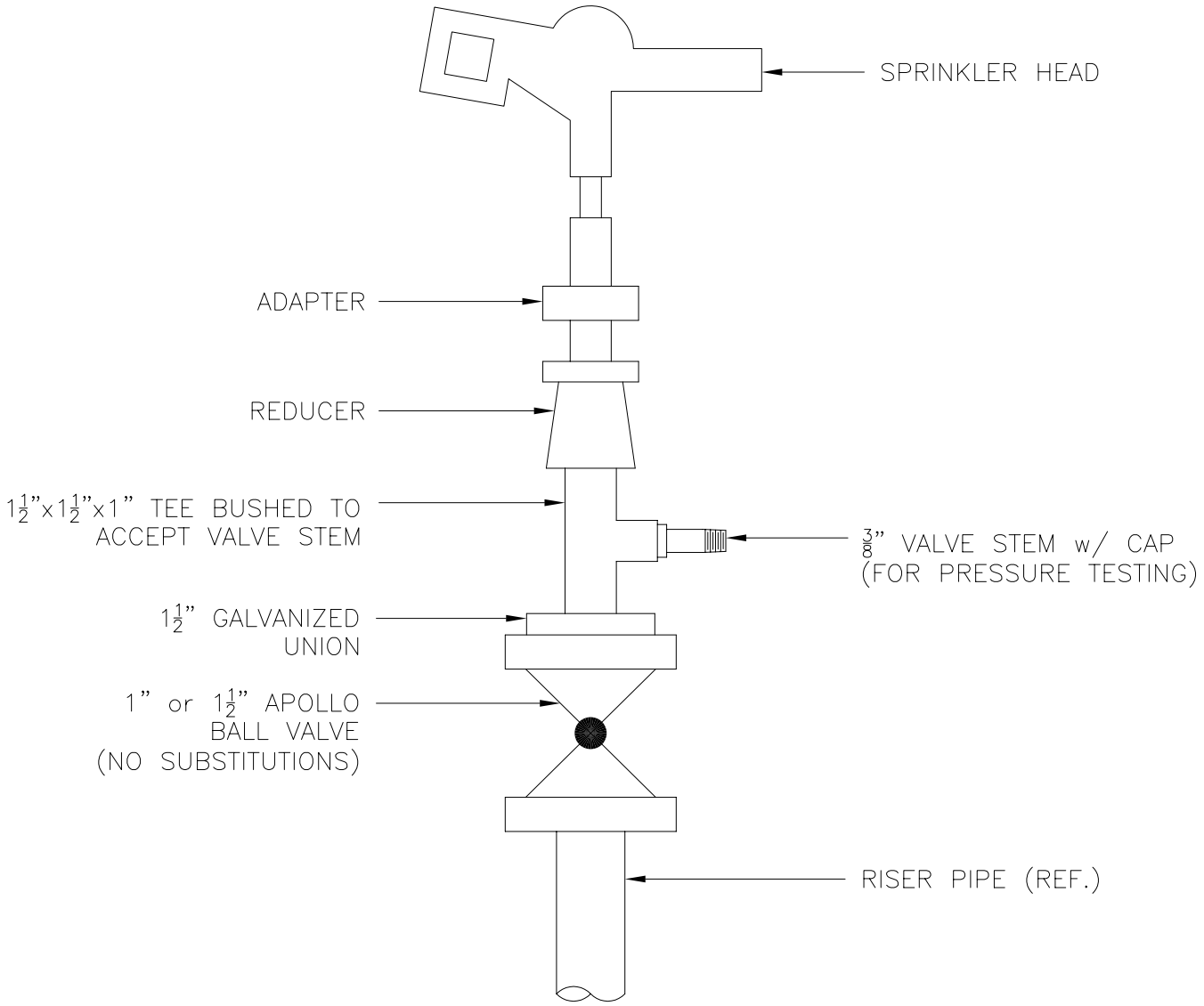
REV. 0



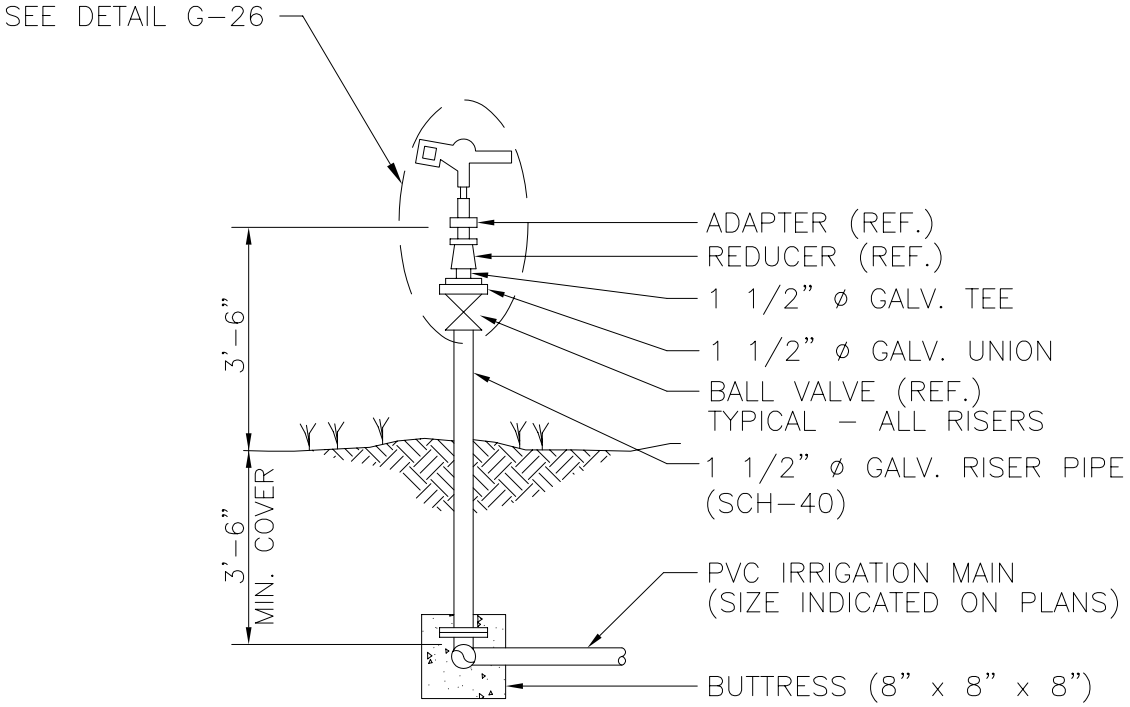
NOTE:

ALL EXCAVATIONS WITH LAGOONS SHALL BE BACKFILLED WITH SUITABLE SOIL AND COMPACTED TO A MINIMUM DENSITY 95% STANDARD PROCTOR (ASTM D698).

CASTLE VALLEY CONSULTANTS	**BUCKINGHAM TOWNSHIP**	**G-25**
SCALE: NOT TO SCALE	**STANDARD DETAIL**	
DATE: 07/30/04	**BENTONITE FABRIC LINING DETAIL**	REV. 0

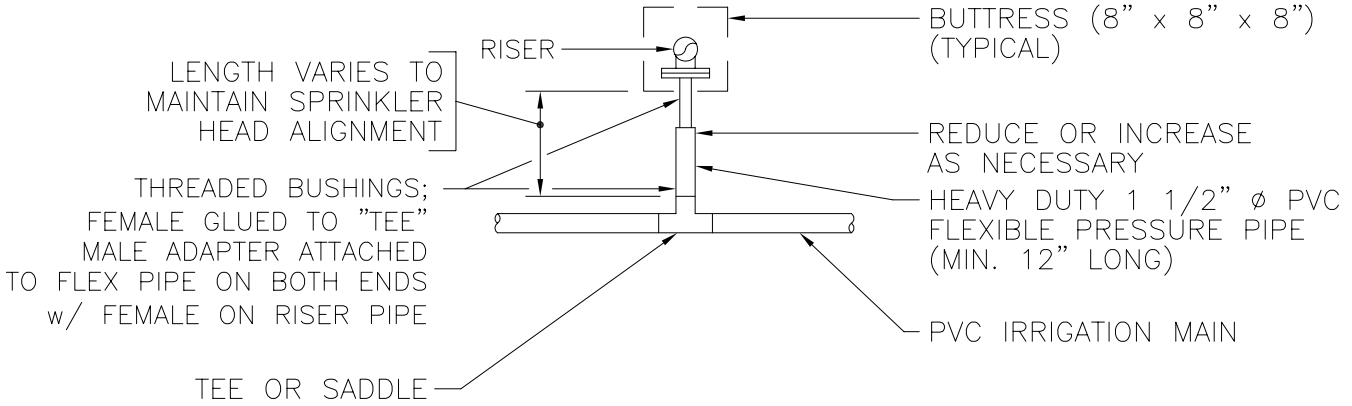


CASTLE VALLEY CONSULTANTS	**BUCKINGHAM TOWNSHIP**	**G-26**
SCALE: NOT TO SCALE	**STANDARD DETAIL**	
DATE: 07/30/04	**SPRINKLER DETAIL**	REV. 0



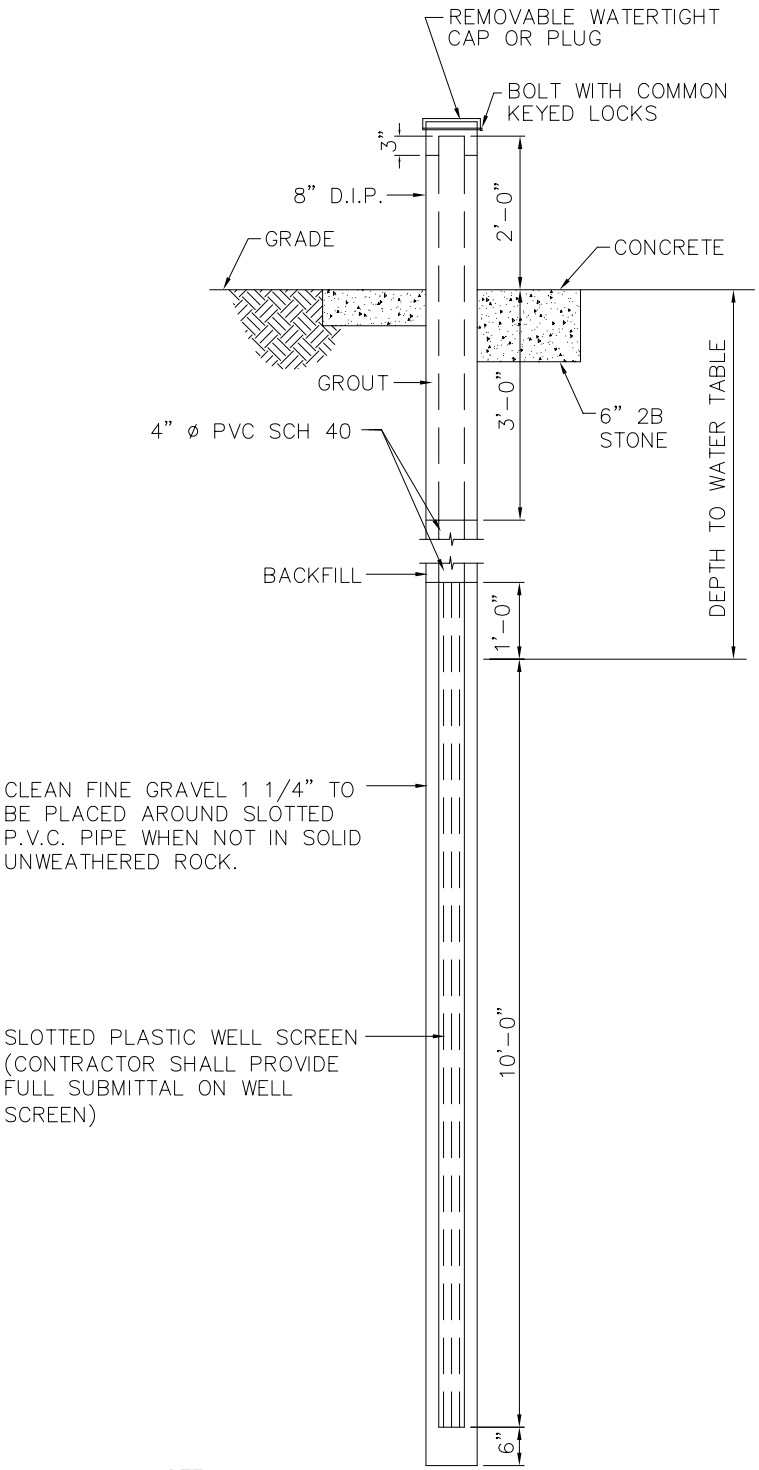
ELEVATION

NOTE:
PRECAST BLOCK ACCEPTABLE IF PLACED ON UNDISTURBED SOIL & SIDES COMPACTED.



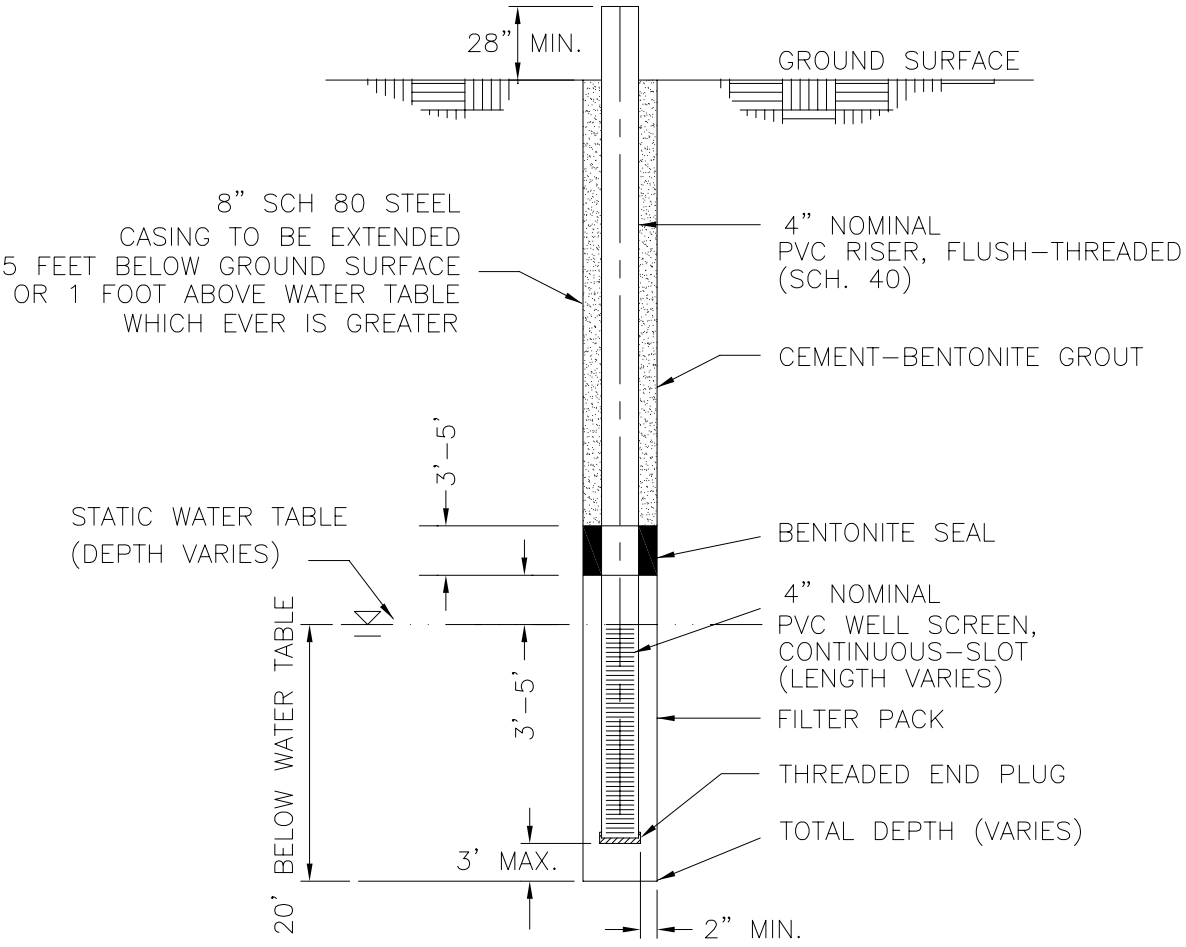
PLAN

CASTLE VALLEY CONSULTANTS	**BUCKINGHAM TOWNSHIP**	**G-27**
SCALE: NOT TO SCALE	**STANDARD DETAIL**	
DATE: 07/30/04	**SPRINKLER RISER DETAIL**	REV. 0

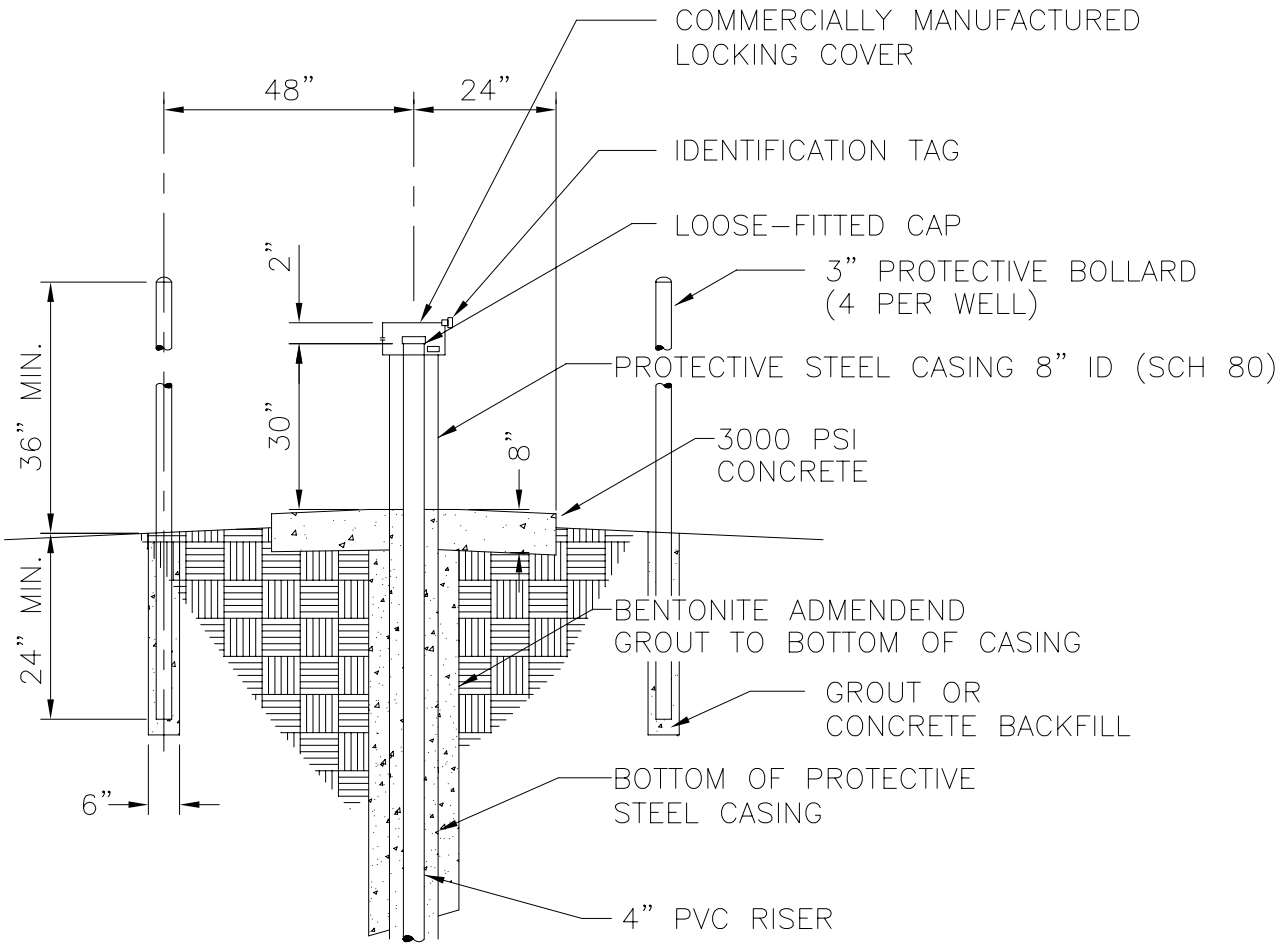


NOTE:
IF SOLID ROCK IS ENCOUNTERED PIPE SHALL BE PLACED TO A DEPTH 5' BELOW TOP OF ROCK OR 10' BELOW WATER TABLE WHICHEVER IS LESS.

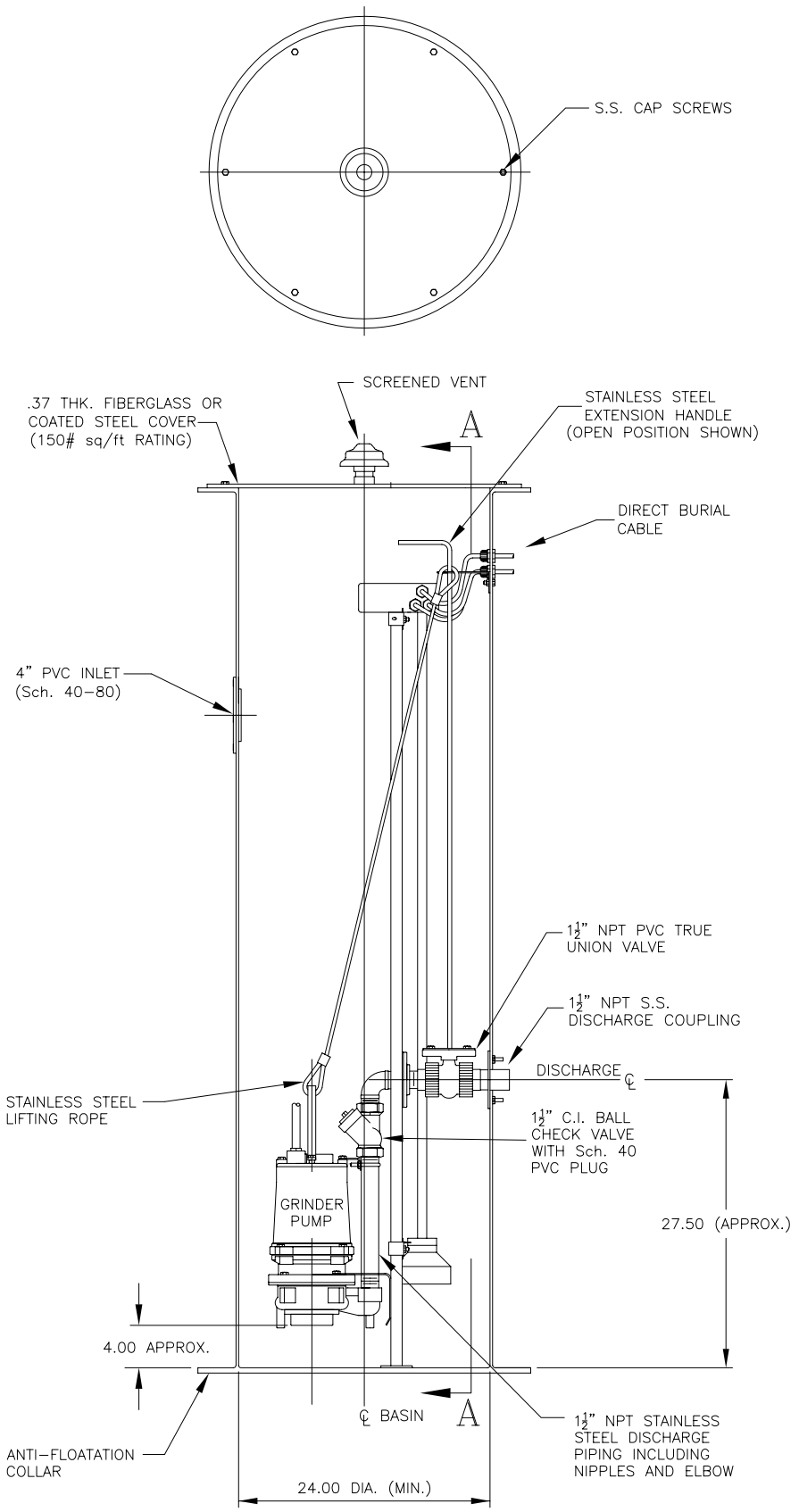
CASTLE VALLEY CONSULTANTS	**BUCKINGHAM TOWNSHIP**	**G-28a**
SCALE: NOT TO SCALE	**STANDARD DETAIL**	
DATE: 07/30/04	**MONITORING WELL DETAIL**	REV. 0



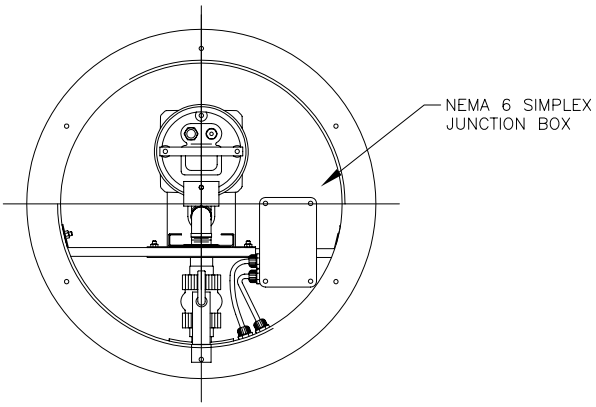
CASTLE VALLEY CONSULTANTS	**BUCKINGHAM TOWNSHIP**	**G-28b**
SCALE: NOT TO SCALE	**STANDARD DETAIL**	
DATE: 07/30/04	**MONITORING WELL CONSTRUCTION DETAIL**	REV. 0



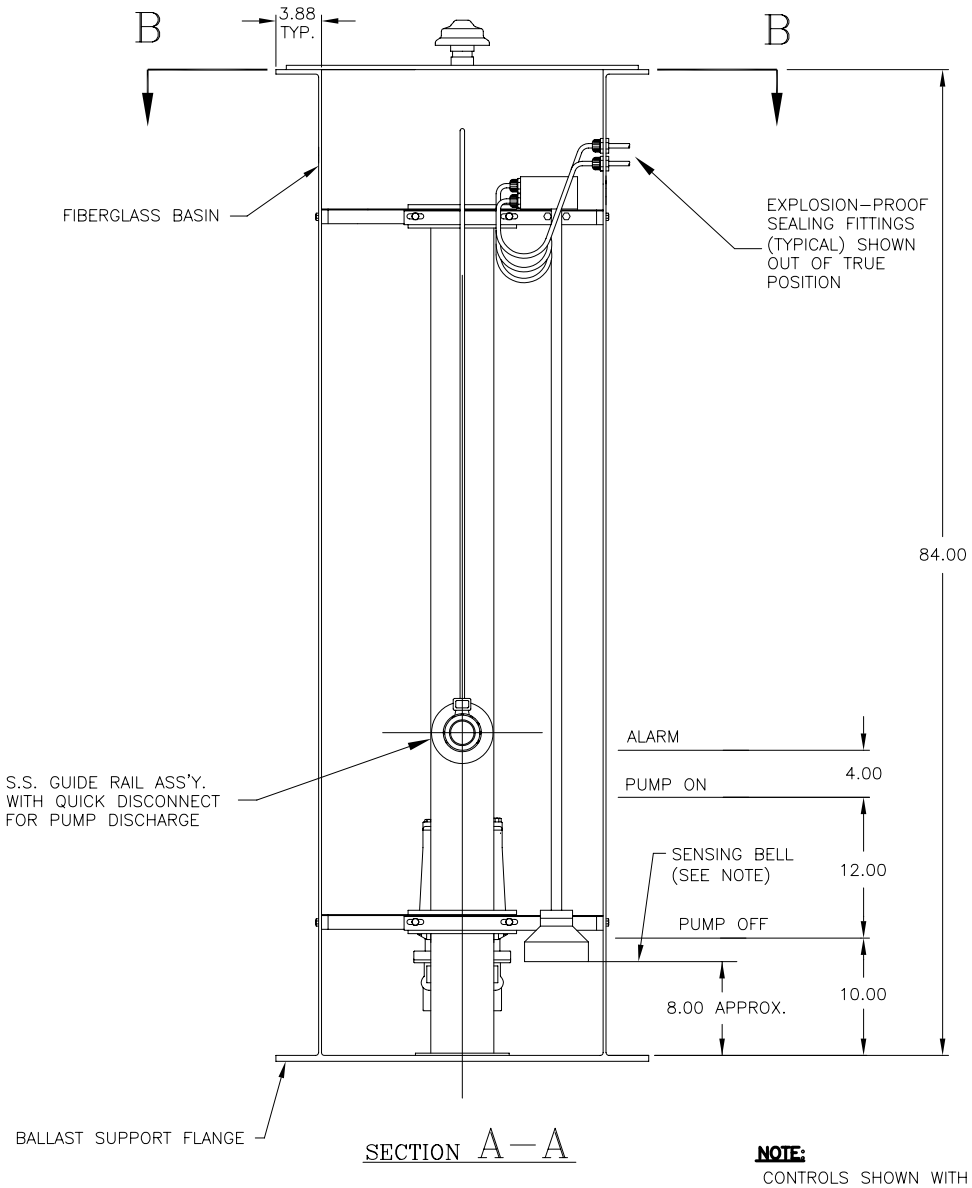
CASTLE VALLEY CONSULTANTS	**BUCKINGHAM TOWNSHIP**	**G-28c**
SCALE: NOT TO SCALE	**STANDARD DETAIL**	
DATE: 07/30/04	**SURFACE COMPLETION DETAILS FOR MONITORING WELLS**	REV. 0



CASTLE VALLEY CONSULTANTS	**BUCKINGHAM TOWNSHIP**	**G-29a**
SCALE: NOT TO SCALE	**STANDARD DETAIL**	
DATE: 07/30/04	**RESIDENTIAL GRINDER PUMP FOR GRAVITY COLLECTION SYSTEMS (1 of 3)**	REV. 0



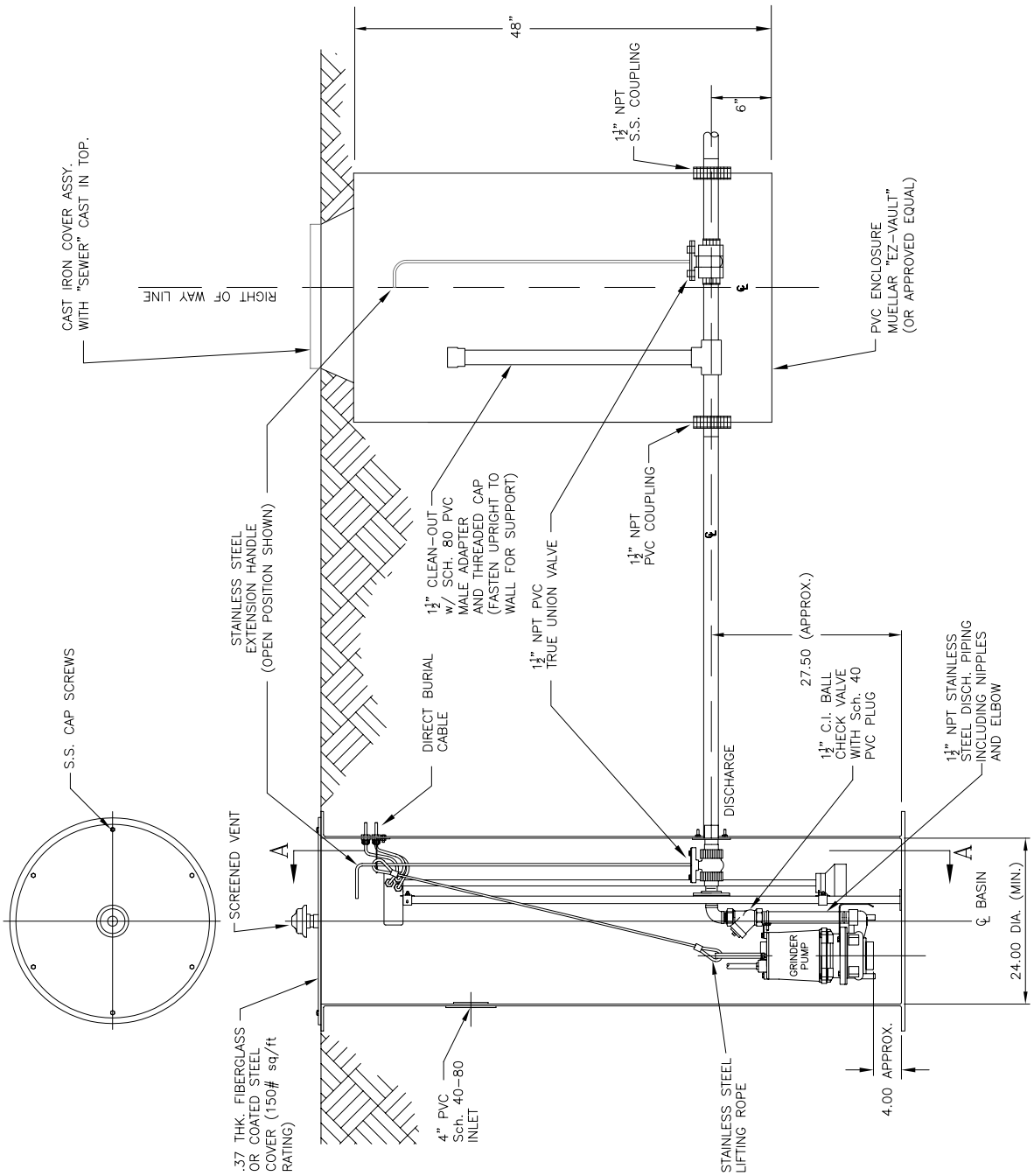
SECTION B–B



SECTION A–A

NOTE:
CONTROLS SHOWN WITH SENSING BELL. CONTRACTOR MAY SUBSTITUTE FLOAT CONTROLS AT HIS DISCRETION.

CASTLE VALLEY CONSULTANTS	**BUCKINGHAM TOWNSHIP**	**G-29b**
SCALE: NOT TO SCALE	**STANDARD DETAIL**	
DATE: 07/30/04	**RESIDENTIAL GRINDER PUMP FOR GRAVITY COLLECTION SYSTEMS (2 of 3)**	REV. 0



CASTLE VALLEY CONSULTANTS	**BUCKINGHAM TOWNSHIP**	**G-29c**
SCALE: NOT TO SCALE	**STANDARD DETAIL**	
DATE: 07/30/04	**RESIDENTIAL GRINDER PUMP FOR GRAVITY COLLECTION SYSTEMS (3 of 3)**	REV. 0

CASTLE VALLEY CONSULTANTS

SCALE: NOT TO SCALE

DATE: 07/30/04

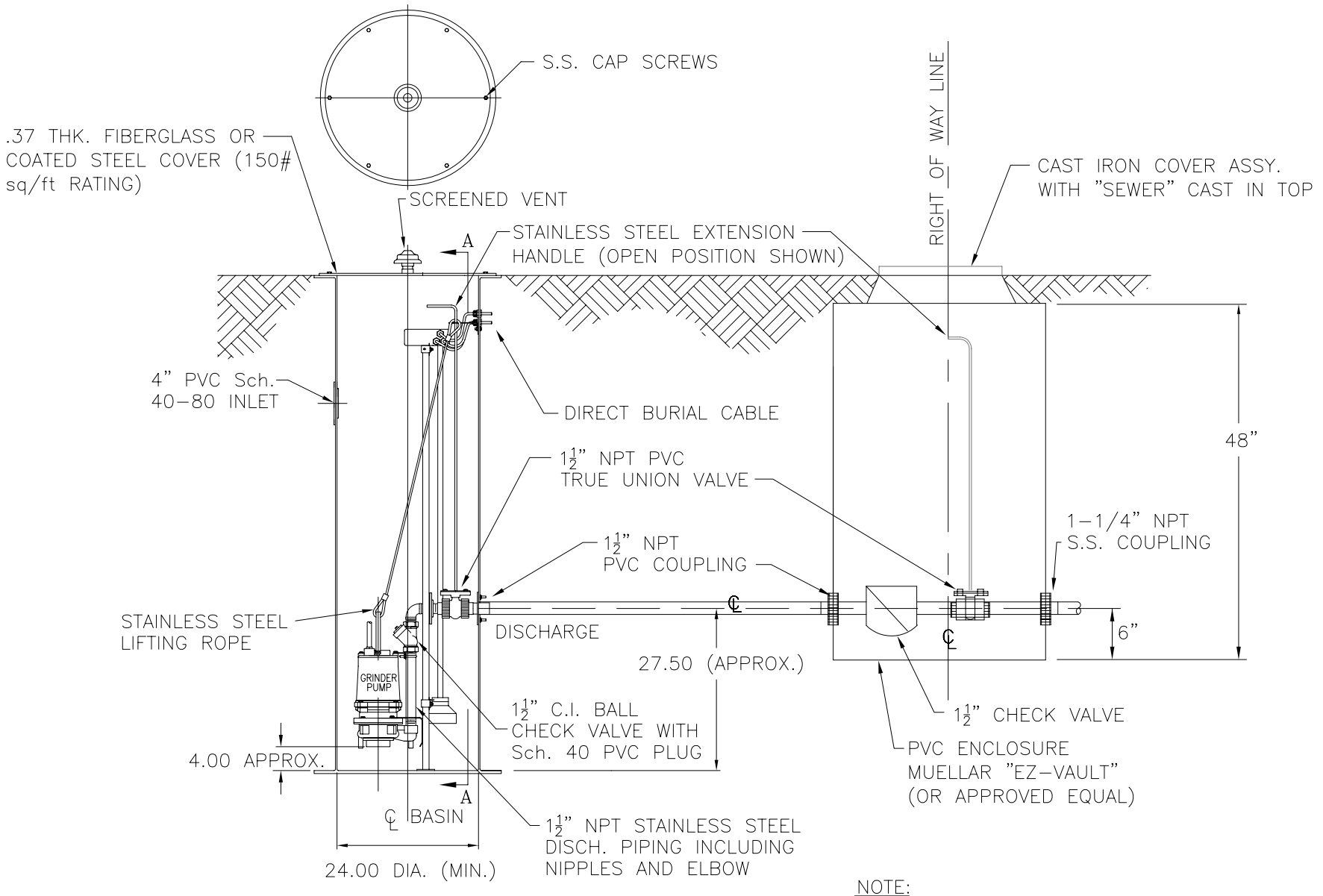
BUCKINGHAM TOWNSHIP

STANDARD DETAIL

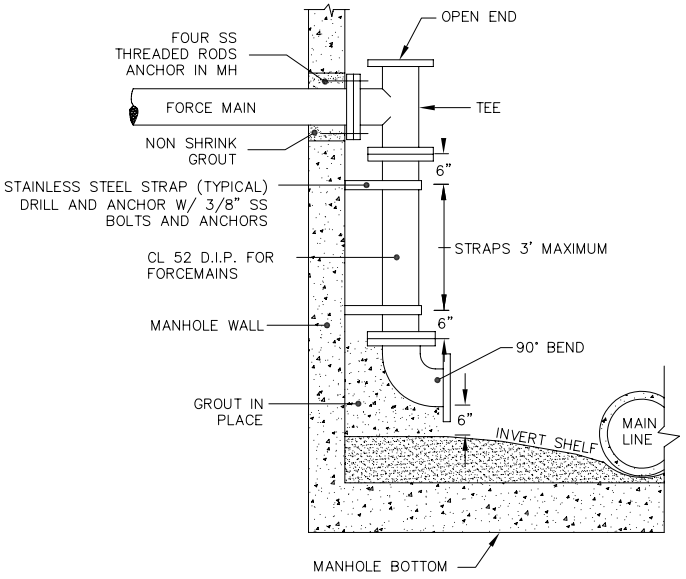
RESIDENTIAL GRINDER PUMP FOR LOW PRESSURE FORCE MAINS

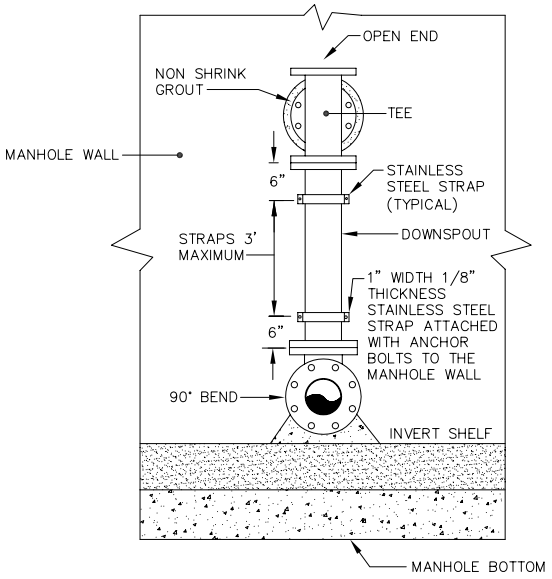
G-29d

REV. 0



NOTE:
CONTROLS SHOWN WITH SENSING BELL. CONTRACTOR MAY SUBSTITUTE FLOAT CONTROLS AT HIS DISCRETION.





NOTES:

1. PIPING CONFIGURATION TO BE USED ON ALL DROPS OVER 20 INCHES.
2. DROPS TO BE CONSTRUCTED OF D.I.P. PIPE.
3. SERVICE LINE MAY NOT ENTER MANHOLE THROUGH CONE SECTION OR ITS JOINT.

CASTLE VALLEY CONSULTANTS	**BUCKINGHAM TOWNSHIP**	**G-30**
SCALE: NOT TO SCALE	**STANDARD DETAIL**	
DATE: 09/20/2004	**INSIDE DROP MANHOLE**	REV 0