B. The word “WATER” shall be cast into the cover or the lid.

PART 3 – EXECUTION

3.1 WATER SERVICE LINE INSTALLATION

A. A service supply line located between the water main, and the inlet side of the water meter is designated as a “water service line.” A service supply line located between the outlet side of the water meter to the point of connection within the limits of the customer’s lot or property is designated as the “customer’s yard piping.”

B. Existing meter and meter box relocation shall be included in the service line installation.

C. The Contractor shall trench and backfill in accordance with the Typical Trench Backfill Standard Detail drawing as shown within the Construction Drawings.

D. Saw cutting, excavation, backfill, and replacement of pavement shall be completed in accordance with the following Project Specifications, whichever are applicable:

1. TxDOT Item 0340, Dense-Graded Hot-Mix Asphalt (Small Quantity)
2. Section 01230, Excavation and Backfill

3.2 BORING SERVICE LINES

A. Bored casing inside diameter shall be 4-inches for 2-inch service lines in accordance with the Service Connection Standard Detail drawings as shown within the Construction Drawings.

B. Steel casing must be used for lateral encased crossings at all TxDOT roadways.

C. HDPE casing may be used for County or residential roadways if approved by Owner/Engineer.

3.3 TAPPING PVC WATER MAINS

A. Single meter service shall include PVC adaptor coupling with corporation stop.

3.4 SINGLE SERVICE LINE- SINGLE AND DUAL METERS

A. Single service lines with single and dual meters shall conform to the Service Connection Standard Detail drawings as shown within the Construction Drawings.

3.5 TAPPING ASBESTOS CEMENT WATER MAINS (AC PIPE)

A. Service line tapping of AC pipe shall be completed during the period immediately before or after hydrostatic pressure testing operations so that subsequent flushing will maximize the elimination of contaminants associated with the tapping process.

B. Direct tapping into the pipe wall without use of a service saddle will not be

allowed.

C. Service saddles must be used when tapping AC pipe.

D. Drill tools shall be used for services less than 2-inches in size.

E. Shell type drills shall be used for all services 2-inches and greater in size.

3.6 RECONNECTING SHORT AND LONG SERVICE LINES

A. New water main(s) to which services are to be reconnected on the same side of the street as the old main, are defined as "short reconnects." Existing services on the opposite side of the street of the new main shall be defined as "long reconnects."

B. Both old and new water mains at existing service line connections shall be exposed.

C. The old water main shall be exposed for the purpose of gaining access to the existing service corporation stop and the new main for the purpose of installing the new corporation stop.

D. The new main shall be exposed for the purpose of being drilled and tapped with an approved tapping machine, a new corporation stop installed under pressure, and the trench extended laterally to expose a sufficient length of the existing service line to provide slack to bend it into position for tying to the new corporation stop.

E. After suitable notification to the customer, the Contractor shall "kill" the existing service by closing the corporation stop, removing the existing flare nut, inserting inside the existing flared nut an appropriately sized copper disc and replacing the existing flared nut on the corporation stop if the main is non-ferrous, or plugging the existing service line at the main if the main is ferrous.

3.7 RELOCATING SHORT AND LONG SERVICES

A. Service relocates are defined as services that are relocated from an alley or street to a side yard or front of street.

B. New water main(s) to which services are to be relocated and are on the same side yard of the street as the customer's new meter box location, are designated as "short relocates."

C. New water main(s) to which services are to be relocated and are on the opposite side of the street from the customer's new meter box location, are designated as "long relocates."

3.8 NEW SHORT AND LONG SERVICES

A. If a new water main is required to be extended to provide water service for new customers, the service lines laid to be connected to the new water main shall be designated as "new services."

B. Newly laid water main(s) to which new services are on the same side of the street as the customer's new meter box location, are designated as "new short services."

C. Newly laid water main(s) to which new services are on the opposite side of the street from the customer's new meter box location, are designated as "new long services."

D. New services shall be installed in accordance with the Service Connection Standard Detail drawing as within the Construction Drawings.

3.9 ABANDONMENT OF SERVICE LINES

A. The Contractor shall accomplish all cutting, capping, and plugging necessary to isolate new service lines transferred to new and existing mains from those that are to be abandoned.

B. The corporation stop for an abandoned service line tapped on a ferrous main shall be removed, and the tap at the main shall be plugged with an appropriately sized brass plug.

C. For a non-ferrous main, the corporation stop shall not be removed from the main. Instead, the corporation stop shall be closed, and the flared nut shall be removed from the corporation stop. After the appropriately sized copper disc is inserted inside the flared nut, replace the flared nut on the corporation stop.

PART 4 – MEASUREMENT AND PAYMENT

4.1 MEASUREMENT:

A. Reconnect short service will be measured by the unit of the various types and sizes of each service line reconnected.

B. Reconnect long service will be measured by the unit of the various types and sizes of each service line reconnected.

C. Relocate short service will be measured by the unit of the various types and sizes of each service line relocated.

D. Relocate long service will be measured by the unit of the various types and sizes of each service line relocated.

E. New short service will be measured by the unit of the various types and sizes of each new service line installed.

F. New long service will be measured by the unit of the various types and sizes of each new service line installed.

4.2 PAYMENT:

A. Payments shall be full compensation for all labor, materials, testing, and equipment necessary for reconnecting short and long services made at the price bid unit for each service line of the various sizes reconnected as shown within the Construction Drawings and as specified herein. This item shall also include, but not necessarily be limited to: excavation and backfilling; dewatering; cutting pavement and surface structures of whatever type encountered and replacement with whatever type specified, polyethylene or copper, corporation stop, and service saddle for short or long service line reconnections.

B. Payments shall be full compensation for all labor, materials, testing, and equipment necessary for relocating short and long services made at the price bid unit for each service line of the various sizes relocated as shown within the Construction Drawings and as specified herein. This item shall also include, but not necessarily be limited to: excavation and backfilling; dewatering; cutting pavement and surface structures of whatever type encountered and replacement with whatever type specified, and polyethylene or copper tubing, meter box and lid (if meter box and lid need to be replaced) for short or long service line relocations.

C. Payments shall be full compensation for all labor, materials, testing, and equipment necessary for new short and long services made at the price bid unit for each service line of the various sizes installed as shown within the Construction Drawings and as specified herein. This item shall also include, but not necessarily be limited to: excavation and backfilling; dewatering; cutting pavement and surface structures of whatever type encountered and replacement with whatever type specified; casing; polyethylene or copper tubing, service saddle, corporation stop, meter box and lid, and ball valve for new short or long service line installations.

END OF SECTION

SECTION 03000
BYPASS PUMPING

PART 1 – GENERAL

1.1 SCOPE

A. The Work covered by this Section consists of furnishing all labor, supervision, tools, equipment, appliances, and materials to perform all operations in segment(s). The purpose of bypass pumping is to prevent sewage overflows and always provide reliable sewer service to the users of the sanitary sewer. The Contractor shall maintain sewage flow in the construction area to prevent back-up and/or overflow into upstream pipe segments and laterals, adjacent ditches, storm sewers, and waterways.

B. Bypass pumping is the installation and operation of bulkheads, plugs, hoses, piping, temporary manholes and sumps, and pumps to maintain wastewater flow and prevent backup and overflow. Bypass pumping provides continuous sewer service to the users of the sanitary sewer system while maintenance or construction operations are in progress by diverting flow, when necessary, around the construction location and pumping it to a downstream manhole.

1.2 SUBMITTALS

A. Submittals shall comply with the requirements in the Contract Documents.

B. The Contractor shall submit a written plan for implementation and sequencing of bypass pumping for review and approval of the Engineer prior to installation of the bypass system. The plan shall include details such as:

1. Project information including the project name, location, and permit number (from plan cover sheet).
2. Contact information for Contractor or submitting entity that includes the company name, contact person (24 hours/day), phone number(s), and fax number.
3. Calculations of static lift, friction loses, and flow velocity, (pump curves showing pump operating range shall be submitted).
4. Proposed pump capacity
5. Proposed size and type of hoses
6. Location of downstream discharge
7. Show any special features were pipes or hoses cross roadways, drainage features, temporary trenches, support bridges, etc.
8. Show temporary manholes, sumps, and connections required for bypass pumping.
9. Staging areas for pumps including a schematic showing the arrangement and layout of the pumping and bypassing facilities at various stages in the work.

10. Sewer plugging method and types of plugs.
11. Length, size, material, location, and method of installation of suction piping, temporary manholes, or temporary sumps (if required).
12. Length, size, material, location, method of installation and location of discharge piping.
13. Pump manufacturer, model, sizes, capacity, and number of each size to be on site and power requirements.
14. Standby power generator size, location (if required).
15. Downstream discharge plan, including method of covering manhole opening and securing manhole from the public.
16. Method of protecting discharge manholes or structures from erosion and damage.
17. Thrust and restraint block sizes and locations.
18. Any temporary pipe supports, and anchoring required.
19. Alarm/alerting plan and contact information.
20. Schedule for installation of and maintenance of bypass pumping lines.

PART 2 - P R O D U C T S

2.1 EQUIPMENT AND MATERIALS

A. The pump and bypass pumping lines shall be of adequate capacity and size to handle the peak wet weather flow conditions. All piping, joints, and accessories shall be designed to withstand at least twice the max system pressure, or a minimum of 50 psi, whichever is greater.

B. Internal and/or external bypass pumping operations shall use 100% leak-proof pipe approved for wastewater use with restrained joints.

C. Pumps shall be fully automatic and solids handling, self-priming or submersible pumps in good working order with a working pressure gauge on the discharge. Self-priming pumps shall not require the use of foot-valves or vacuum pumps in the priming system. All pumps used must be constructed to allow dry running for long periods of time to accommodate the cyclical nature of effluent flows. The Contractor shall provide the necessary start/stop controls for each pump. A backup pump of the same capacity as the primary pump shall be always maintained on site to be used if the primary pump fails.

D. No wastewater shall be allowed to drain or stand in earthen sump pits.

E. Pumping between the hours 9:00 p.m. to 8:00 a.m. shall use sound attenuated pumps as the primary pumps. The back-up pump does not have to be sound attenuated and may be used as the primary pump between the hours of 8:00 a.m. and 8:00 p.m. Sound attenuated pumps shall reduce noise generated by the equipment to a maximum of 70 dBA when measured 30 feet from the pump.

F. The Contractor shall be required to demonstrate that the pumping system is in

good working order and is sufficiently sized to successfully handle flows by performing a test run for a period of 24 hours prior to beginning the Work.

G. Any wastewater back-ups and/or overflows as the result of inadequate equipment are the responsibility of the Contractor.

H. The Contractor shall be required to have all materials, equipment, and labor necessary to complete the repair or replacement on the job site prior to isolating the wastewater manhole and beginning bypass pumping operations.

PART 3 - EXECUTION

3.1 CONSTRUCTION METHODS

A. Maintain sewage flow to prevent backup or overflow onto streets, yards and unpaved areas or into buildings, adjacent ditches, storm sewers, and waterways. The Contractor shall take all necessary steps to prevent flooding of public or private property. Maintaining flow inside the existing pipe during rehabilitation operations is preferred.

B. It is the sole responsibility of the Contractor to locate and identify all existing sewer lines and services and to provide any and all labor, material, equipment, techniques, and methods to bypass pump as necessary for his construction methods and to monitor the effectiveness of this installed system and its effect on adjacent facilities.

C. The Contractor is responsible for implementing an alert system that will call or signal the Contractor and Owner of pump failure or sewage overflow for the entire duration of bypass pumping operations (both working/daytime and off work/nighttime hours).

D. Temporary plugs used for bypass pumping shall be reinforced with secondary plugs if the primary plug is compromised. Plugs shall be redundantly tethered to ensure that they are not lost in the wastewater collector system. Deviations from these requirements will be reviewed by the Engineer. Plugs shall be properly maintained and fully operational during all bypass pumping activities. Contractor is responsible for retrieving any bypass pumping equipment, including temporary plugs that enter the wastewater system.

E. Contractor shall complete the Work as quickly as possible and satisfactorily pass all tests, inspections, and repair all deficiencies prior to discontinuing bypass pumping operations and returning flow to the sewer manhole or line segment.

F. The Contractor will monitor levels to ensure the system does not surcharge above allowable levels.

G. During bypass pumping, do not allow sewage to be leaked, dumped, or spilled in or onto any area outside of the existing sanitary sewer system.

H. In the event of accidental spill or overflow, immediately stop the discharge and take action to clean up and disinfect the spill. Promptly notify the Owner so that required reporting can be made to the Texas Commission on Environmental Quality (TCEQ) and the Environmental Protection Agency (EPA) by the Owner. In the event of accidental spill or overflow, the Contractor is responsible for any damages that may have occurred to public or private property including cleaning, disinfection, and other corrections to the satisfaction of the Engineer at no cost to the Owner.

I. Contractor shall not intentionally damage, alter, or remove portions of the existing sewer system structures for the purpose of installing a bypass pumping system without specific approval from the Engineer or Inspector. If a structure is damaged, it shall be reconstructed or replaced to the satisfaction of the Engineer at no additional cost to the Owner.

J. The Contractor shall be responsible for any and all damage that results directly or indirectly from the interference of storm water runoff to bypassing equipment, piping, and/or appurtenances.

K. When bypass pumping operations are complete, piping shall be drained into the sanitary sewer prior to disassembly, and all pumps and lines shall be flushed with clean water until all discharge is clear.

3.2 TRAFFIC CONSIDERATIONS

A. The Contractor shall locate bypass pump(s) and discharge lines in a manner that does not cause unnecessary or excessive interference with the use of streets, private driveways, and alleys. Traffic control shall be performed under the approval and/or specifications of the respective City, County or State directives.

B. Ingress and egress to adjacent properties shall be always maintained. Contractor shall provide ramps, steel plates or other methods over temporary surface piping to facilitate access to adjacent properties.

3.3 SCHEDULING

A. The Contractor shall report any bypass pumping activities not included in the submitted plan to the Engineer prior to proceeding with these activities.

B. The Contractor shall cease bypass pumping operations when directed by the Engineer.

PART 4 – MEASUREMENT AND PAYMENT

4.1 MEASUREMENT:

A. Unless shown on the Drawings or called out within these Specifications as a pay item, no separate payment will be made for the installation, operation, and maintenance of bypass pumping system for any lateral service work or mains less than or equal to 6-inches.

B. When included as a contract pay item, measurement for bypass pumping shall be on per calendar day basis. Bypass pumping set-up and operation for 8-inch and larger sanitary sewer main will be a contract pay item. The Contractor will not be paid for bypass pumping when pumps are not in operation.

4.2 PAYMENT:

A. The Work performed and materials are furnished as described by this item and measured under the "Measurement" subsection, will be paid at the unit price bid, when included as a contract pay item. Unit prices shall be full compensation for

furnishing all labor, equipment, time, materials, and incidentals necessary to complete the Work.

END OF SECTION

SECTION 03100
SANITARY SEWER MAIN

PART 1 - GENERAL

1.1 SCOPE

A. The Work included in this Section consists of furnishing all material, equipment, labor and performing all operations necessary for the installation, adjustment or replacement of sanitary sewer mains, and stubs of the size and type specified in the Drawings and all applicable Work such as excavating, bedding, jointing, backfilling materials, testing and all other accessories within the limits of Work, as shown on the Drawings and specified herein.

B. Where references are made to other standards or codes unless specific date references are indicated the latest edition of said standard or code shall govern.

1.2 RELATED SECTIONS

A. Section 01230, Excavation and Backfill

B. Section 01240, Trench Excavation Safety

C. Section 01500, Concrete for Structures

D. Section 01600, Concrete Encasement, Cradles, Caps and Seals

E. Section 02670, Ductile Iron Fittings

F. Section 02680, Joint Restraints and Thrust Blocking

G. Section 03120, Sanitary Service Laterals

H. Section 03220, Bulkheads

I. Section 03400, Sanitary Sewer Main TV Inspection

J. Section 03410, Sanitary Sewer Testing

K. Section 04815, Concrete Encasement

1.3 REFERENCE STANDARDS

A. Texas Commission of Environmental Quality (TCEQ)

1. Chapter 217 – Design for Domestic Wastewater Systems

2. Chapter 213 – Edwards Aquifer

B. Comply with the current American Water Works Association (AWWA) standards for materials relating to water distribution systems.

1.4 SUBMITTALS

A. Shop Drawings

1. Submit Manufacturer's product data, instructions, recommendations, and certificate of conformance with referenced standards. Indicate sizes and types to be installed.
2. Submit proposed methods, equipment, material, and sequence of operation for sewer construction.
3. Submit Manufacturer's specifications for the tracer wire. Indicate size and print legend to be installed.
4. Submit Manufacturer's specifications for the detectable marker tape. Indicate size and color code to be installed.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Pipe shall be unloaded and inspected in accordance with the manufacturer's instructions. Inspect each shipment of pipe and fittings and make provision for a timely replacement of any damaged material.

B. Pipe stored on the site shall be stored in the protective unit packages provided by the manufacturer. If packages need to be opened, the pipe shall be stored on a flat surface and not in direct contact with the ground. Do not stack higher than four (4) feet. Keep inside of pipe and fittings free from dirt and debris. Care shall be exercised to avoid compression damage or deformation to the pipe.

C. All pipe that are stored shall be covered to provide protection from the sunlight. Provide for air circulation through the stockpile.

D. Always handle all material carefully. Unload by hand or use canvas slings to avoid scratching the pipe. Do not slide or drag PVC pipe over an abrasive surface. Pipe with deep scratches shall be replaced with new pipe and removed from the site. Any pipe or fitting having a crack, or which has received a severe blow shall be marked rejected and immediately be removed from the work.

PART 2 – PRODUCTS

2.1 POLYVINYLCHLORIDE (PVC) SEWER MAIN (NONPRESSURE)

A. Materials

1. All PVC pressure sewer main shall be SDR 26 (ASTM D 3034) with a pressure rating of 115 psi minimum for mains sizes less than 15-inches in diameter or 72 psi minimum for larger mains unless stated otherwise on the Drawings.
2. All sanitary sewer PVC pipe shall be **green**. White pipe is prohibited.

B. Pipe Markings

1. PVC sewer main permanent markings shall include the following at intervals of not more than five (5) feet:
    a. Manufacturer's name or trademark
    b. Nominal pipe size
    c. PVC cell classification per ASTM D 1734

i. For pipe sizes 6-inch to 15-inch in diameter: ASTM D 3034, type PSM, SDR 26 PVC Sewer Pipe

ii. For pipe sizes 18-inch and larger: ASTM F 679, T-1 wall PVC Sewer Pipe.

C. Standards

1. Any PVC sewer mains having a deflection of the inside diameter greater than 5% after 30 days of installation will not be accepted.

2. All PVC sewer mains shall pass the low-pressure test, as described in 30 TAC § 217.57.

3. At waterline crossings and where water and sewer mains are parallel and separation distance cannot be achieved as per TAC § 217.53, use higher pressure rated pipe SDR 26 (ASTM D2241-09) with a pressure rating of 150 psi. This shall include all lateral piping as well.

2.2 PRESSURE PIPE/FORCE MAINS

A. Materials

1. Size and Pressure Ratings

a. Pressure or force mains shall be constructed of PVC class 200 (SDR 26) for pipes less than 12-inch diameter.

b. Pressure or force mains shall be constructed of ductile iron pipe Pressure Class 250 minimum for pipes greater than 12-inch diameter.

2.3 PIPE JOINT RESTRAINTS AND THRUST BLOCKING

A. Pipe joint restraints and thrust blocking shall conform to all requirements with all requirements of Section 02680 of these Specifications.

2.4 DUCTILE IRON FITTINGS

A. All buried fittings shall be ductile iron with mechanical joints and shall conform to all requirements within Section 02670 of these Specifications.

2.5 PIPE TRACER WIRE

A. Tracer wire shall be installed on all non-ductile iron sewer main. Tracer wire shall be No. 12 AWG copper-clad steel, extra high-strength with minimum 1,150-lb break load and 30 mil HDPE insulation.

B. Tracer wire shall be taped or zip-tied to the main pipeline in a minimum of 60-inch increments.

C. A conductivity test shall be made on all wire installed. Tests and visual inspection shall be made at each valve box, meter box and listening port as applicable. Conductivity may be tested by using as electrical conductivity meter by attaching underground locating equipment and tracing the signal to each valve box and meter box. No acceptance or payment will be made on any section or reach of

pipe installed that does not have a conductive electrical locator wire installed in accordance with the Drawings.

2.2 MARKER TAPE

A. Marker tape shall be installed as an additional pipe identification device when pipe is installed by open trench method only.

B. During the backfilling process, all sanitary sewer mains and force mains, sewer service laterals and system appurtenances shall have a continuous warning tape placed immediately above them and throughout their length at a depth of eighteen (18) inches above the utility line surface. The tape shall be six (6) inches wide. Tape material shall be formulated from 100 percent virgin polyolefin resins. Resins shall be pigmental for chemical stability and resistance to sulfide staining (color fastness). Tape shall be constructed by the mechanical (non-adhesive) lamination of two piles of three layers blown film in such a manner as to produce a bi-axially oriented structure. The tape shall be able to provide a 700 percent elongation prior to rupture as per ASTM-D882.

C. The warning tape shall be manufactured with a permanent American Public Works Administration (APWA) green color pigment and at a max of every thirty (30) inches along its length, be imprinted with the applicable continuous warning message as follows:

1. CAUTION: BURIED FORCE MAIN BELOW
2. CAUTION: SANITARY SEWER LINE BELOW
3. CAUTION: BURIED STORM SEWER MAIN LINE BELOW
4. CAUTION: STORM DRAIN LINE BELOW

2.6 PROHIBITED PIPE

A. The following pipe shall NOT be used:

1. Concrete pipe
2. Asbestos-cement (AC) pipe
3. Fiberglass reinforced sewer pipe (non-pressure type)
4. Concrete steel cylinder pipe

PART 3 – EXECUTION

3.1 SEWER MAIN INSTALLATION

A. The Contractor shall commence installation of the pipe at the downstream end of the sanitary sewer main. Pipe installation shall proceed upgrade (in an upstream direction) with the bell pointing in the upstream direction of flow.

B. No pipe shall be laid within 10 feet of any point where excavation is in progress.

C. Pipe shall be lowered into the trench without disturbing the prepared foundation or the trench sides.

D. The drilling of lifting holes in the field will not be permitted.

E. Pipe shall be installed by means of a concentric pressure being applied to the pipe with a mechanical pipe puller. Pulling or pushing a joint of pipe in pace using a crane, bulldozer or backhoe will not be permitted. Pipe shall be pulled in a straight line with all parts of the pipe online and grade at all times. No side movement of the pipe will be permitted during or after the pulling operation.

F. Should coupled joints of pipe be out of line or off grade, they shall be removed one joint at a time in the presence of the Inspector and brought to the proper line and grade. The lifting or moving of several joints of coupled pipe at one time to close a partially open joint or fine grade under laid joints of pipe will not be permitted.

G. No horizontal or vertical curves shall be permitted in conformance with appropriate regulatory agency requirements.

H. Before leaving the work unattended, the upper ends of all pipelines shall be securely closed with a tight-fitting plug or closure. The interior of laid pipe shall be kept free from dirt, silt, gravel, or foreign material at all times.

I. All pipes in place must be approved by the Inspector before backfilling.

J. When replacing an existing system in place, the Contractor shall maintain screens to prevent the entrance of construction debris into the sewer system.

K. Where not otherwise indicated, all sewer main shall be laid to the following minimum depths:

1. Sewer main installed in natural ground in easements or other undeveloped areas, which are not within existing or planned streets, roads, or other traffic areas shall be laid at least 36 inches of cover for wastewater service.

2. Sewer main installed in existing streets, roads, or other traffic areas shall be laid with at least 60 inches of cover.

3. Sewer main installed in such proposed streets shall be laid with at least 42 inches of cover below the actual subgrade.

3.2 PIPE SEPARATION

A. Where gravity and force main sewers are constructed in the vicinity of water mains, the requirements of the 30 TAC § 217.53 shall be met.

1. Collection system pipes must be installed in trenches separate from water supply trenches.

2. Wherever possible, a collection system pipe must be located below a water supply pipe. A sewer collection system pipe that parallels must have a vertical separation of at least (2) two feet between outside diameters of pipe or at least four (4) feet of horizontal separation.

3. Wherever possible, collection system pipes and manholes should be located at least (9) nine feet from all water supply pipes.

4. If a collection system pipe cannot be located below a water supply pipe; or, a collection system pipe or manhole cannot be located at least (9) nine feet from all water supply pipes, refer to Figure 30 TAC §217.53(d)(3) for design criteria and protection requirements.

5. A sewer collection system pipe that crosses a public water supply pipe or parallels a water supply pipe within (9) nine feet shall be constructed per the following:

   a. DR 18 (150 PSI) per AWWA C900 for PVC pipe smaller than 12-inch diameter

   b. DR 25 (165 PSI) per AWWA C905 for PVC pipe larger than 12-inch diameter

3.3 TEMPORARY PIPE PLUGS, CAPS, BULKHEADS AND TREANCH CAPS

A. Temporary plugs, caps, or plywood bulkheads shall be installed to close all openings of the pipe and fittings when pipe construction is not in progress.

B. All temporary end plugs or caps shall conform to all requirements within Section 03220 of these Specifications.

C. Trench caps shall be reinforced Class D concrete as indicated.

3.4 CONCRETE ENCASEMENT, CRADLES, CAPS, AND SEALS

A. When trench foundation is excessively wet or unstable or installation of water or wastewater pipe will result in less than 36 inches of cover, Contractor shall notify Engineer and Owner. The Engineer and Owner may require the Contractor to install a concrete seal, cradle, cap, encasement, or other appropriate action.

B. All concrete cap, etc., shall be continuous and begin and end within 6 inches of pipe joints. Concrete caps, cradles, and encasement shall conform to Section 01600 of these Specifications. The pipe shall be well secured to prevent shifting or flotation while the concrete is being placed.

PART 4 – MEASUREMENT AND PAYMENT

4.1 MEASUREMENT: The quantity measured for payment shall be per linear foot for each size diameter, types, and classes of main. Parallel lines will be measured individually. Where a main ties into an existing system, the length of the new main will be measured from the visible end of the existing system at the completed joint. Unless otherwise indicated, the length of sanitary sewer mains will be measured along main horizontal centerline stationing through manholes, junctions, and other appurtenances.

4.2 PAYMENT: Payment shall be full compensation for all labor, materials, testing, and equipment necessary for furnishing, installing, adjustment or replacement of sanitary sewer mains, and stubs, of the size and type specified by the open cut method regardless of trench depth as per the Drawings and specified within. This item shall also include, but not necessarily be limited to all types and sizes of main; tracer wire; marker tape; bulkheads; elected embedment; compaction; sanitary sewer testing; excavation and backfill; trench excavation safety; and vertical stacks on deep sewer main services.

END OF SECTION

SECTION 03120
SEWER SERVICE LATERALS

PART 1 – GENERAL

1.1 SCOPE

A. The Work included in this Section consists of furnishing all labor, supervision, tools, equipment, materials, and requirements for sewer service laterals to the sanitary sewer mains.

B. Where references are made to other standards or codes, unless specific date references are indicated, the latest edition of said standard code shall govern.

1.2 DESCRIPTION OF REQUIREMENTS

A. The Contractor shall furnish and install single service laterals in accordance with DTL #302 standard detail shown within the Drawings.

1.3 RELATED SECTIONS

A. Section 01230, Excavation and Backfill

B. Section 01240, Trench Excavation Safety

C. Section 01500, Concrete for Structures

D. Section 02670, Ductile Iron Fittings

E. Section 03100, Sanitary Sewer Mains

F. Section 03200, Sanitary Sewer Manholes

G. Section 03410, Sanitary Sewer Testing

1.4 REFERENCED STANDARDS

A. American Society for Testing and Materials (ASTM) International

1.5 SUBMITTALS

A. Submit materials required to establish compliance with these Specifications. Submittals shall include the following:

1. Certified drawings showing all important details of construction and dimensions.
2. Descriptive literature, bulletins and/or catalogs of the equipment.
3. The total weight of each item.
4. Additional submittal data, where noted with individual pieces of equipment.

PART 2 – PRODUCTS

2.1 SERVICE CONNECTIONS

A. Service connections shall be installed at the locations designated by the Owner and in conformity to the same ditching and bedding detail as used on the main sewer line construction.

B. The maximum diameter of service connections to main sewer lines shall be a 4-inch.

C. Service lines larger than 4-inch shall be connected to manholes.

2.2 FITTINGS

A. Wyes shall be 8-inch, 10-inch, 12-inch, etc., by 4 inches of the same material as the main line pipe and shall have the same type gasketed connections.

B. Bends shall be standard 4-inch, 11.25° (1/8) pipe bends. Bends and joints shall be as specified for service pipe.

C. Service pipe installed as part of main sewer line construction shall be standard 4-inch service pipe. Polyvinyl Chloride (PVC) service pipe shall be 4-inch SDR 35 pipe which complies with the same requirements as the main sewer, conforming to ASTM D3034, F-794 or F-949 with gasketed joints and all required markings consistent with main line material.

D. Service pipe installed by a plumber in conjunction with a main line tap, existing stub out or manhole shall be either 4-inch ductile iron, SCH 40 PVC, or PVC pipe consistent with the existing stub out pipe (see section 2.2.C above).

PART 3 – EXECUTION

3.1 INSTALLATION OF SERVICE LINES ON NEW SEWER CONSTRUCTION:

A. Service connections shall be properly installed at the required locations. All wyes, bends, sanitary sewer main and other appurtenances shall be provided as required for each connection. All joints shall be installed to provide watertight connections.

B. Catalog cuts and related data for all material shall be submitted to the Owner and the Engineer for review.

C. Wye joints shall be installed as directed, with the branch turned to the proper direction, or as shown on the plans. Wyes shall be firmly supported by methods and materials used for bedding of main line pipe. Branch of wyes shall be installed at an angle 45° to the springline unless grade requirements dictate otherwise

D. Bends for service lines shall be placed in the wyes per the Drawings, or where necessary for proper alignment.

E. When installed during sewer line construction, service pipe shall be installed to the proper line and grade from the sewer line to the property line at a grade of not less than 1/4" per foot. Backfilling and bedding procedures shall be as for sewer mains. Watertight plugs shall be placed in the end of service line stubs. Plugs shall be as recommended by the pipe manufacturer and shall be installed in accordance with the Manufacturer's recommendation. Suitable markers shall be installed at the ends of service line stubs for above ground location. A suitable marker shall include a

section of pipe of the same material as service line extended one to two feet above ground surface.

1. Service line stub locations at the property line shall be recorded by the Contractor and furnished to the Engineer to be included on the as-built Drawings.

2. Service line locations shall be referenced to the station location of the main at the point the service line intersects the sewer main. In the event a service line is not installed at a 90° angle to the sewer main, the station of the service line at the property line shall be referenced to the main line station. The information shall also include the perpendicular distance from the center of the sewer main to the end of the service line and the depth of the sewer line.

3. The service line location data referenced in item 2 above shall be included on the as-built Drawings.

3.2 SERVICE CONNECTIONS TO EXISTING LINES:

A. Materials:

1. Minimum pipe size for new connections to either existing sewer main lines or manholes shall be 4 inches.

2. All sanitary sewer PVC pipe shall be **green**. White pipe is prohibited.

3. Taps into existing sewer main lines shall use a gasketed fitting in conjunction with a "Predco Fastfit" sewer tap saddle or ROMAC CB Sewer Saddle or approved equal. Saddles shall be mounted on pipe according to Manufacturer's recommendations.

4. Taps directly into manholes shall be made by coring the manhole wall and installing the proper size manhole boot.

B. Installation:

1. Taps will not be made prior to applicable fees being paid and a sewer connection permit being obtained from the Owner.

2. The main line will be tapped only when no service line stub is available. In the event the service line stub cannot be located by the Owner personnel, the plumber/ contractor will be allowed to tap the line. Service line shall be installed at an angle of 45° to the springline unless grade requirements dictate otherwise.

3. Ties to Existing Service Line Stubs:

   a. Connection shall be made with the proper watertight connector suitable for the application.

   b. Connection shall remain visible until inspection by the Owner and/or Engineer.

   c. Backfill shall be carefully placed and tamped around the connection as to prevent any settlement or movement.

4. Taps to Sewer Main Lines:

a. Tap saddles shall be installed in accordance with Manufacturer's recommendations.

b. Holes for saddles shall be 4.5 inches in diameter and shall be made by mechanical hole cutters or by keyhole saw or saber saw only. “Hammer Taps” are not approved. Holes shall be laid out with a template at an angle of 45° to the vertical (unless grade requirements dictate otherwise) and shall be deburred and carefully beveled to provide a smooth hole shaped to conform to the fitting. Care shall be taken to prevent any foreign material from entering the cut-in pipe opening. Any material or debris that does enter the line shall be removed.

c. Where applicable, saddle and pipe mating surfaces shall be wiped clean and dry. Epoxy cement shall be used in cementing in accordance with the cement manufacturer's recommendations and ASTM D2855.

d. Service line shall be connected to the Predco tap saddle or Romac CD saddle by means of a fixture specified by the tap saddle Manufacturer.

e. Tap inspections shall be conducted after hole is cut, but before connection is made up.

f. If integrity of sewer main is breached during tap installation:

   i. Where the installation of the tap causes visible cracks or splits in the clay sewer line, the sewer main line will be encased in concrete for the full length of the cracked pipe.

   ii. Where the installation of the tap causes visible cracks or splits in the PVC sewer line, the cracked sewer line shall be cut out and replaced with a section of the appropriate size SDR-35 PVC using gasketed, PVC, bell x bell or bell x spigot couplings or approved equal watertight coupling suitable for the application. The EFT shall determine the length of damaged sewer main to be replaced to remove all damaged material. The EFT, at their discretion, may approve “Fernco” or similar rubber, strapped, couplings in making PVC or DIP main-sewer pipe connections.

   iii. Any sewer line damaged during the installation of a tap, shall be repaired at no cost to the Owner.

g. In the event water is entering into the ditch, the contractor/plumber shall pump the ditch as dry as necessary to make the complete connection visible at the time of inspection.

h. Backfill shall be carefully placed and tamped around the connection so as to prevent any settlement or movement. Where a cracked pipe is encased in concrete, backfilling shall not commence until the encasement has hardened.

5. Taps to Manholes:

   a. Service line must enter manhole at angle no less than 90° to the

direction of flow.

b. For manholes less than 12 feet in depth:

i. Plumber/contractor shall core drill the manhole wall directly above manhole table to a diameter specified by the manhole boot manufacturer. If the slope of table is less than 2 1/2" per foot, the invert of service line shall enter manhole 6" above table, and a suitable service invert formed on the table.

ii. Pipe connections shall be made by a flexible synthetic rubber boot mechanically clamped to the manhole and to the pipe to provide a watertight seal and designed to accommodate pipe movement up to 2 inches radically or 22 degrees angularly in any direction. The synthetic rubber boot shall have a minimum wall thickness of 3/8 inch. The synthetic rubber material shall conform to ASTM C-923. Bands, clamps and other metal accessories shall be of Series 304 stainless steel. Approved manhole boots shall be Kor-N-Seal as Manufactured by NPC or PSX Direct Drive as manufactured by Press-Seal or equal.

iii. The void area inside the manhole boot shall be filled with non-shrink grout such as "Preco Plug" or approved equivalent, and walls shall be troweled smooth.

iv. A curved trough shall be formed on/in manhole table to direct flow into the main invert. If the service enters below the table, then table must be removed and a new trough formed.

v. Tap inspections shall be held before backfilling commences. Work must be visible and dewatered during inspection.

vi. Backfill shall be carefully placed and tamped around the connection so as to prevent any settlement or movement and shall commence only after non-shrink grout has sufficiently hardened.

c. For manholes greater than 13.5 feet in depth, an inside drop may be installed. Inside drops on existing (4-foot inside diameter) manholes are allowed for 6” services; however, it is critical that the drop be constructed so as minimize the intrusion into the manhole. Also, no restriction of the normal use of the manhole steps is allowed.

i. Plumber/contractor shall core drill the manhole wall a minimum of four feet below ground surface. If four feet cannot be obtained, notify the Owner and Engineer before proceeding.

ii. A manhole boot shall be installed as given in paragraph 5.b above.

iii. Service pipe shall be inserted through the manhole wall.

iv. A tee shall be placed on pipe with run horizontal for clean out, and a PVC plug, with a section removed, inserted in the run of the tee. The half-plug will create a dam prevent high

flows from overrunning the drop but will permit the entry of rodding tools for cleaning.

v. The drop pipe shall extend to the manhole table and a 45° bend shall be installed on the end. The 45° bend shall be rotated toward the direction of water flow in the invert.

vi. Inside piping shall be secured to the manhole wall by means a stainless-steel strap spaced every 4 vertical feet and securely anchored to manhole wall. The space between the entering pipe and the manhole opening shall be sealed with a non-shrink grout.

vii. A curved trough shall be formed on/in manhole table to direct flow into main invert. The trough shall extend beyond the opening of the 45° bend to its curvature or change in direction.

viii. The void area inside the manhole boot shall be filled with non-shrink grout such as "Preco Plug" or approved equivalent, and the walls shall be troweled smooth.

ix. Tap inspection shall be held before backfilling commences. Work must be visible and dewatered.

x. Backfill shall be carefully placed and tamped around the connection so as to prevent any settlement or movement only after non-shrink grout has sufficiently hardened.

xi. The Owner reserves the right to deny the installation of an inside drop for any reason. If an inside drop is planned, the plumber should contact the Engineer to confirm approval prior to proceeding with the work.

C. Inspection of Taps to Existing Sewer Main Lines:

1. Plumber shall contact the Owner approximately eight hours before tap inspection will be needed. Tap to main lines shall remain unconnected and dewatered until the tap has been approved by the Owner and/or Engineer.

2. In the event a road or street must be cut in order to make the connection, the plumber will obtain any and all permits to conduct work in public right of way; and have it at the job site at the time of the inspection.

3. Service lines over 100 feet in length shall be tested for infiltration and exfiltration per Section 03410 of these Specifications.

4. If tap fails inspection, the connection will be corrected at no expense to the Owner. Another inspection is required after correction and tap shall remain uncovered and dewatered until tap passes inspection.

6. Failed Inspections:

a. Any tap which fails inspection shall be corrected within 5 working days, after the date on which the first inspection was performed.

b. The Owner and Engineer shall be notified of any tap which is not corrected and successfully re-inspected within this time frame.

PART 4 – MEASUREMENT AND PAYMENT

4.1 MEASUREMENT: Sewer service laterals shall be measured by each unit installed at the various diameter sizes and type of material.

4.2 PAYMENT: Payment shall be full compensation for all labor, materials, testing, and equipment necessary for furnishing and installing sewer service laterals by the unit of various diameter sizes by open cut method regardless of trench depth as per the Drawings. This item shall include, but not necessarily be limited to all materials including pipe; pipe fittings (to include wyes, tees, bends, and other appurtenances); gaskets; bypass pumping; excavation and backfill; trench excavation safety; surface restoration; testing; cutting pavement; concrete support and all other work incidental to the installation of sewer service laterals.

END OF SECTION

SECTION 03200

SANITARY SEWER MANHOLES

PART 1 – G E N E R A L

1.1 SCOPE

A. The Work included in this Section consist of furnishing all material, equipment, labor and performing all operations necessary for the installation, adjustment or replacement of sanitary sewer manholes including protective coating, excavation, installation, backfilling and surface restoration.

B. Where references are made to other standards or codes unless specific date references are indicated the latest edition of said standard or code shall govern.

1.2 RELATED SECTIONS

A. Section 01230, Excavation and Backfill

B. Section 01500, Concrete for Structures

C. Section 03100, Sanitary Sewer Main

D. Section 03210, Frames, Grates, Rings, and Covers

E. Section 03220, Bulkheads

F. Section 03400, Sewer TV Inspection

1.3 REFERENCE STANDARDS

A. Texas Commission on Environmental Quality (TCEQ)

1. Chapter 213 – Edwards Aquifer
2. Chapter 217 – Design Criteria for Domestic Wastewater Systems

B. American Society for Testing Materials (AASHTO)

1. M306: Standard Specification for Drainage, Sewer, Utility, and Related Castings

C. American Society of Engineers (ASME)

1. ASME B 16.1 – Cast Iron Pipe Flanges and Flanged Fittings

D. American Society for Testing and Materials (ASTM)

1. A 307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile
2. A 536: Standard Specification for Ductile Iron Castings
3. A 615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
4. C 443 - Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets

5. C 478 - Standard Specification for Precast Reinforced Concrete Manhole Sections

6. C 890 - Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures

7. C 913 – Standard Specifications for Precast Concrete Water and Wastewater Structures

8. C 923 – Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals

9. C 990 – Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants

10. D 638 - Test Method for Tensile Properties of Plastics

11. D 648 - Standard Test Method for Deflection Temperature of Plastics under Flexural Load in the Edgewise Position.

12. D 698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft.)

13. D 790 - Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

14. D 1238 - Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer

15. D 1505 - Standard Test Method for Density of Plastics by the Density-Gradient Technique

16. D 1693 - Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics

17. D 2665 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste and Vent Pipe and Fittings

18. D 4787 - Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates

19. D 7234 - Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers

E. National Association of Corrosion Engineers (NACE)

1. SPO 188 - Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates

1.4 SUBMITTALS

The submittal requirements of this specification item include:

A. Type, size, and manufacturer of manhole (diameter of water or wastewater manhole), structure (precast, cast in place, standard, Tee, etc.), and materials and equipment to be furnished (concrete, seals, rings, covers, etc.)

B. Aggregate types, gradations, and physical characteristics for the Portland cement concrete mix.

C. Proposed proportioning of materials for the mortar mix.

D. Proposed product for coating the interior surface of new and/or existing wastewater manholes.

E. Submit the following procedures.

1. Acceptance testing procedure
2. Associated test equipment and materials type structures
3. Adjustment technique

F. Submit test record reports to include as a minimum of the following items:

1. Name of manhole Manufacturer
2. Interior surface coating type and application method for wastewater manholes
3. Protective coating test reports
4. Model and Manufacturer of vacuum tester
5. Test method used.
6. Date tested and re-tested
7. Passed or fail. If failed, describe what was done to correct the problem.
8. Location and station of manhole
9. Precast and cast-in place bottom
10. Description of repairs made to joints, if any.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. All items shall be unloaded and inspected in accordance with the Manufacturer's instructions. Inspect each manhole segment and make provision for a timely replacement of any damaged material.

PART 2 – P R O D U C T S

2.1 MATERIALS

A. Concrete and cement stabilizing sand

1. All concrete shall be provided in accordance with Section 01500, Concrete for Structures of these Specifications.
2. The cast in place concrete shall be Class A. The precast concrete manhole base section, riser section, and appurtenances shall conform to the applicable requirements of ASTM C 478.
3. Concrete for backfill of over-excavated areas shall be Class A or Class J as indicated in the Drawings.
4. Cement stabilized sand for bedding or backfilling, when indicated or required on the Drawings, shall contain two bags of Portland Cement per

cubic yard.

5. The sand shall meet the requirements for fine aggregate in accordance with Section 01500 of these Project Specifications.

B. Mortar

1. The mortar shall be composed of one part Portland cement, one part masonry cement (or 1/4 part hydrated lime), and sand equal to 2-1/2 to 3 times the sum of the volumes of the cements and lime used. The sand shall meet the requirements for "Fine Aggregate" within Section 01500 of these Specifications.

C. Reinforcement Steel

1. The reinforcement steel shall be provided in accordance with Section 01500 of these Project Specifications. Secondary, non-structural steel in cast-in-place wastewater manholes may be replaced by collated fibrillated polypropylene fibers, if approved by the Engineer and Owner.

D. Pre-Cast Concrete Manhole Components

1. All constructed manholes shall be watertight and equipped with pre-tested and approved rings and covers. New manholes shall conform to the applicable requirements of ASTM C 478.

2. Precast Base Sections, Riser Sections, and Cones

a. The width of the invert shall be specifically sized for the connecting sewer mains. Inverts shall be “U” shaped with a minimum depth of three fourths of the largest main diameter. Where sewer mains enter the manhole up to 24 inches above the flowline of the outlet, the invert shall be filleted to prevent splashing and solid deposition. A drop sewer main shall be provided for a sewer entering a manhole at more than 24 inches above the flowline of the outlet.

b. Joints for concrete base sections, riser sections, and cones shall conform to the requirements of ASTM C 443. Precast bases for 78 inches inside diameter manholes shall have performed inverts. Inserts acceptable to the Engineer shall be embedded in the concrete wall of the manhole sections to facilitate handling; however, through-wall holes for lifting shall not be permitted. Any voids between the sewer main and boot shall be filled with a product recommended by the manhole Manufacturer to prevent solids collection.

3. Precast junction boxes

a. Precast junction boxes shall be allowed only where indicated on the Drawings or acceptable to the Engineer. Joints for wastewater junction boxes shall conform to the requirements of ASTM C 443.

b. Precast bases and precast junction boxes shall have flexible, resilient and noncorrosive boot connectors or ring waterstops acceptable to the Engineer conforming to the requirements of ASTM C 923 on all wastewater pipe connections.

4. Precast grade rings

   a. Rings shall be reinforced Class A or I concrete.

   b. Precast grade rings at 24 ½ inches inside diameter

      i. The adjustment ring shall be used only for adjusting manholes with 24-inch lids. Inside to outside diameter dimension of the ring shall be 6 inches with a thickness of 3 inches to 6 inches.

   c. Precast grade rings at 35 inches inside diameter

      i. The adjustment ring shall be used for all new manhole construction with 32-inch lids. Inside to outside diameter dimension of the ring shall be 6 inches with a thickness of 4 inches to 6 inches.

E. New Manhole Construction and Minor Manhole Adjustment:

1. New manhole construction and minor manhole adjustments shall be performed in accordance with the Typical New Manhole Construction and Minor Manhole Adjustment Detail (DTL#322) as per the Drawings and shall consist of adding precast reinforced concrete rings to adjust the manhole to final grade.

2. For new manhole construction, the maximum vertical allowable ring adjustment, including the depth of the ring casting, shall be limited to 18 inches.

3. For adjustments of existing manholes that fall within the limits of overlay and street reconstruction projects, the maximum vertical allowable, including the depth of the ring casting, shall be limited to two feet.

4. All other existing manholes shall have a maximum allowable ring adjustment, including the depth of the ring casting, of one foot.

5. Any adjustment that will exceed these requirements shall be accomplished in accordance with the Typical Major Manhole Adjustment Detail (DTL #321) and as described below in subsection (H). All manholes not located in paved areas shall have bolted covers.

F. Interior Surface Coating for Wastewater Manholes: The interior surface of new manholes should be property prepared prior to product application in accordance with NACE No.6/SSPC-SP13. Interior surfaces shall be coated with one of the following products:

1. Carboline Plasite 4500 Series – 125 mils

2. Raven 405 – 125 mils

3. SprayWall – 125 mills

G. Manhole Rings and Covers: Rings and covers shall be provided in accordance with Section 03210 of these Project Specifications.

H. Bulkheads: Bulkheads shall be provided in accordance with Section 03220 of these Project Specifications.

I. Waterproofing joint materials O-rings and wedge seals for the joints of all

wastewater manholes shall conform with ASTM C 443. The connections between reinforced concrete wastewater manhole structures and sewer mains shall meet the requirements for ASTM C 923.

PART 3 - E X E C U T I O N

3.1 INSTALLATION

A. Manholes shall be constructed of materials and workmanship as prescribed by these Project Specifications, at such places shown in the contract documents or as designated by the Engineer, and in conformity with the typical Details. The Inspector will inspect all sewer mains before it is placed in the trench and will reject any sections found to be damaged or defective to a degree that would affect the structural integrity of the sewer main. Rejected sewer main shall be immediately removed from the site and replaced with new acceptable sewer main.

B. Contractor shall insure that all existing or proposed manholes or structures shall always remain visible and accessible. No manhole or structure covers shall be covered by pavement, equipment, or other obstructions other than removable, temporary lid provided for safety. Inspector shall cause Work to be suspended until this requirement is met without any valid claims of costs or schedule delays.

C. All manholes shall have a minimum inside diameter of 48 inches. Manhole base section or junction box dimension shall be appropriately increased to accommodate all converging sewer main. A minimum horizontal clearance of 12 inches shall be maintained between adjacent sewer mains. Sewer main ends within the base section or junction box walls shall not be relied upon to support overlying manhole dead and live load weights. All wastewater branch connections to new or existing mains shall be made at manholes with the influent main crown installed at the elevation of the effluent main crown. Where lines enter the manhole up to 24 inches above the flowline of the outlet, the invert shall be sloped upward to receive the flow, thus preventing splashing or solids deposition. Where the spring line of an influent main is 24 inches or more above the spring line of the effluent main, a drop manhole shall be used. Construction of extensions to existing systems shall require placement of bulkheads at locations indicated or directed by the Engineer or Owner. Unless otherwise indicated on the Drawings; wastewater manholes shall have concentric cones, except on manholes over large mains where an eccentric cone shall be situated to provide access to an invert ledge. Eccentric cones may be used where conflicts with other utilities dictate. Flat-slab tops may be used where clearance problems exist.

D. Manholes shall be founded at the established elevations on uniformly stable subgrade. Unstable subgrade shall be over-excavated a minimum of 12 inches and replaced with a material acceptable to the Engineer and/or Owner. Precast base units shall be founded and leveled on a 6-inch coarse aggregate bedding. A sewer main section with a prefabricated tee manhole and half the length of the adjoining sewer main sections on each side shall be founded on a minimum of 6-inch unreinforced Class A concrete. The cast-in-place concrete cradle shall be placed against undisturbed trench walls up to the sewer main's spring line.

E. All adjustments shall be completed prior to the placement of the final surface.

F. Manhole components to be reused shall be carefully removed and the contact areas shall be cleaned of all mortar, concrete, grease and sealing compounds. Any items broken in the process of removal and cleaning shall be replaced in kind by the Contractor at its expense.

G. If the adjustment involves lowering the top of a manhole, a sufficient depth of precast concrete rings or brick courses shall be removed to permit reconstruction. The mortar shall be cleaned from the top surface remaining in place and from all brick or concrete rings to be reused and the manhole rebuilt to the required elevation. The manhole ring and cover shall then be installed with the top surface conforming to the proposed grade.

H. If the adjustment involves raising the elevation of the top of the manhole in accordance with section 2.1.G, the top of brick or concrete ring shall be cleaned and built up vertically to the new elevation, using new or salvaged concrete rings and the ring and cover installed with the top surface conforming to the proposed grade.

I. Cast-in-place foundations shall have a minimum depth of 12 inches at the invert flowline. The widths of all manhole inverts shall be specifically sized for the connecting sewer mains. Inverts shall be “U” shaped with a minimum depth of three fourths of the largest sewer main diameter. The lowermost riser section may be set in the Portland cement concrete, while still green, after which the foundation shall be cured a minimum of 24 hours prior to proceeding with construction of the manhole up to 12 feet in depth. The foundation shall be cured an additional 24 hours prior to continuing construction above the 12-foot level. Manhole depth shall be measured from the invert flowline to the finish surface elevation.

J. Wastewater manholes having cast in place foundations may be constructed over existing sewer mains, except polyvinyl chloride (PVC), and the top half of the sewer main removed to facilitate invert construction. The manhole bottom shall rise from the spring line elevation of the sewer main, approximately one inch for each 12 inches of run (1:12,8%). Wastewater manholes with lines larger than 18 inches shall require precast bases; manholes constructed over in-service mains, however, may be built on cast-in-place foundations if the flow cannot be interrupted. Precast and cast-in-place wastewater junction boxes shall be allowed only were indicated on the Drawings.

K. Sewer mains, except reinforced concrete mains, set in cast-in-place foundations, shall require a water stop seal or gasket around the outside perimeter of the main. It shall be approximately centered under the manhole section wall.

L. Cast-in-place wastewater manholes, junction boxes and flat-slab transitions shall be reinforced, Class A concrete in accordance with Section 01500, Concrete for Structures, of these Project Specifications. Forms will be required for all cast-in-place walls above the foundation. Where the surrounding material can be trimmed to a smooth vertical face, outside forms may be omitted.

M. Backfilling for manholes shall conform to the density requirements of Section 01230, Excavation and Backfill. Manhole construction in roadways may be staged to facilitate base construction. Manholes constructed to interim elevations shall be covered with steel plates of sufficient thickness to support vehicular traffic. Steel plates on wastewater manholes shall be set in mortar to minimize inflow. Manholes shall be completed to finish elevation prior to placement of the roadway's finish

surface. The excavation for completion of manhole construction shall be backfilled with cement stabilized sand with 2 sacks of cement per cubic yard up to the bottom of Portland Cement pavement slabs or to within 2 inches of finish elevation of asphaltic concrete pavements. The cement stabilized sand shall be a minimum of 12 inches thick.

N. After rings and covers are set to grade, the inside and outside of the concrete rings shall be wiped with mortar so placed as to form a durable water-tight joint smooth and even with the manhole cone section. No grouting shall be performed when the atmospheric temperature is at or below 40°F (5°C), and when necessary, because of a sudden drop in temperature, joints shall be protected against freezing for at least 24 hours.

O. When applying manhole protective coating, surface is to be prepped per NACE No.6/SSPC-SP13 with 125 mils of approved protective coating per the Manufacturer's instructions.

P. Joints on sewer pipes shall not be cast or constructed within the wall sections of manholes.

Q. Voids between exterior pipe walls and manhole walls at all pipe connections in manholes shall be filled with a non-shrink grout, concrete or mortar, as approved by the Engineer or as shown in the contract documents and inspected prior to backfilling.

R. Where connections to existing manholes are required, the adjacent pipe bedding shall be prepared to proper grade, the existing manhole neatly cut and the new pipe inserted so that the end is projecting 2 inches from the inside wall. The invert shall then be reshaped to properly channel new flows. Debris of any kind shall be kept out of new or existing manholes or mains.

S. Manhole Ring Encasement: All manhole rings shall be encased with 4,000 psi reinforced concrete as shown in the contract documents or as approved by the Engineer. Concrete manhole ring encasement shall extend 6 inches below the top of the cone and have a minimum width when measured at the manhole ring of 1 foot. The surface of the encasement shall be flush with the top of the manhole ring. Where manholes are constructed in existing streets and where directed by the Engineer or shown in the contract documents, the exterior exposed surfaces of the ring, mortar; throat rings and manhole surface shall be coated with a ⅛ inch minimum thickness of mastic or plastic prior to placement of concrete.

3.2 TESTING FOR WASTEWATER MANHOLES

Manholes shall be tested separately and independently of sanitary sewer mains. All new manholes must pass a leakage test. The contractor shall test each manhole (after assembly and backfilling) for leakage, separate and independent of all other sanitary sewer mains, by means of either a hydrostatic test, vacuum test, or other methods approved by the Engineer. The Contractor is hereby instructed to conduct either of the two identified tests in the following manner:

A. Vacuum Method: A vacuum test shall be performed by the Contractor prior to backfilling those manholes that fall within the right-of-way that require detouring of vehicular traffic. A second vacuum test will not be required after backfilling and compaction is complete unless there is evidence that the manhole has been

damaged or disturbed subsequent to the initial vacuum test.

For manhole installations which do not require detouring of vehicular traffic, the vacuum method is recommended and may be used by the Contractor prior to backfilling the manhole to ensure proper installation so that defects may be located and repaired; however, a vacuum test shall be performed after backfilling, and compaction are complete. Testing after backfilling and compaction are complete will be the basis for acceptance of the manhole.

1. Equipment:

    a. The manhole vacuum tester shall be a device approved for use by the Engineer and/or Owner.

    b. Pipe sealing plugs shall have a load resisting capacity equal to or greater than that required for the size of the connected pipe to be sealed.

2. Procedures for new installed 4'-0" diameter manholes

    a. Manhole section interiors shall be carefully inspected; units found to have through-wall lift holes, or any penetration of the interior surface by inserts provided to facilitate handling, will not be accepted. Coating shall be applied after the testing unless coating is applied before installation or unless it is applied at the factory. All lift holes and exterior joints shall be plugged with an acceptable non-shrink grout. No grout shall be placed in horizontal joints.

    b. After cleaning the interior surfaces of the manhole, the Contractor shall place and inflate pneumatic plugs in all the connecting pipes to isolate the manhole; sealing pressure within the plugs shall be as recommended by the plug manufacturer. Plugs and the ends of pipes connected by flexible boots-shall be blocked to prevent their movement during the vacuum test.

    c. The vacuum test head shall be placed on the top of the cone section or, inside of the top of the manhole cone section, and the compression seal band inflated to the pressure recommended by its manufacturer. The vacuum pump shall be connected to the outlet port with the valve open. When a vacuum of 10 inches of mercury (-5 psig) has been attained, the valve shall be closed and the time noted. Tampering with the test equipment will not be allowed.

    d. The manhole shall have passed the test if the vacuum does not drop below 9 inches of mercury (-4.5 psig) within three (3) minutes of the time the valve was closed. The actual vacuum shall be recorded at the end of the three (3) minutes during which the valve was closed.

    e. When the standard vacuum test cannot be performed because of design or material constraints (examples: T-Type manholes, T-Lock Liners, or other reasons acceptable to the Engineer or designated representative), testing of individual joints shall be performed as directed by the Engineer or designated representative.

B. Exfiltration Method: At the discretion of the Engineer and/or the Owner, the Contractor may substitute the Exfiltration Method of testing for the Vacuum test described in Subsection 3.2.A above. This method may only be used when ground water is not present. If ground water is present a Vacuum Test shall be used unless otherwise directed by the Engineer and/or the Owner. All backfilling and compaction shall be completed prior to the commencement of testing. The procedures for this test shall include the following:

1. Manhole section interiors shall be carefully inspected; units found to have through wall lift holes, or any penetration of the interior surface by inserts provided to facilitate handling, will not be accepted. Coating shall be applied after the testing unless coating is applied before field assembly, or at the factory. All lift holes and exterior joints shall be plugged with an acceptable non-shrink grout. No grout shall be placed in horizontal joints

2. After cleaning the interior surface of the manhole, the Contractor shall place and inflate pneumatic plugs in all of the connecting pipes to isolate the manhole; sealing pressure within the plugs shall be as recommended by the plug Manufacturer.

3. Concrete manholes shall be filled with water or otherwise thoroughly wetted for a period of 24 hours prior to testing.

4. At the start of the test, the manhole shall be filled to the top with water. The test time shall be 1 hour (60 minutes). The Construction Inspector must be present for observation during the entire time of the test. Permissible loss of water in the 1-hour test time is 0.025 gallons per diameter foot, per foot of manhole depth. For a 4-foot diameter manhole, this quantity converts to a maximum permissible drop in the water level (from the top of the manhole cone) of 0.05 inches per foot of manhole depth or 0.5 inches for a 10-foot-deep manhole.

C. Failure to Pass and Records: If the manhole fails to pass the initial test method as described in (A) Vacuum Method and, if allowed, (B) Exfiltration Method, or if visible groundwater leakage into the manhole is observed, the Contractor shall locate the leak, if necessary, by disassembly of the manhole. The Contractor shall check the gaskets and replace them if necessary. The Contractor may re-lubricate the joints and re-assemble the manhole, or the Contractor may install an acceptable exterior joint sealing product on all joints and then retest the manhole. If any manhole fails the vacuum and/or exfiltration test twice, the Contractor shall consider replacing that manhole. If the Contractor chooses to attempt to repair that manhole, the manhole must be retested until it passes. In no case shall cold applied preformed plastic gaskets be used for repair. Records of all manhole testing shall be made available to the Engineer and/or the Owner at the close of each working day, or as otherwise directed. Any damaged or visually defective products, or any products out of acceptable tolerance shall be removed from the site.

D. Protective Coating Testing:

1. Spark (Holiday)Test – After the coating product(s) have cured in accordance with manufacturer recommendations, all surfaces shall be inspected for holidays per NACE RPO188-99 or ASTM D4787 standards. All detected holidays shall be marked and repaired according to the

coating product(s) Manufacturer's recommendations.

a. Test voltage shall be a minimum of 100 volts per mil of coating system thickness.

b. Detection of a known or induced holiday in the coating product shall be confirmed to ensure proper operation of the test unit.

c. All areas repaired shall be retested following cure of the repair material(s).

2. Adhesion Test - Adhesion of the coating system to the substrate shall be confirmed in a minimum of 5% of the manholes coated (no fewer than 1 manhole). After the coating product(s) have cured in accordance with manufacturer recommendations, testing shall be conducted in accordance with ASTM D7234 standard. Owner's representative shall select the manholes and areas to be tested.

E. Inspection: The Engineer or designated representative shall make a visual inspection of each manhole after it has passed the testing requirements and is in its final condition. The inspection shall determine the completeness of the manhole; any defects shall be corrected to the satisfaction of Engineer or Owner.

PART 4 – MEASUREMENT AND PAYMENT

4.1 MEASUREMENT:

A. Sanitary sewer manholes will be measured by the unit of each completed junction box and manhole from zero feet to eight (8) feet in depth.

B. Sanitary sewer manholes and junction boxes deeper than eight (8) feet shall be measured by the number of vertical feet in excess to eight (8) feet.

4.2 PAYMENT:

A. Payment shall be full compensation for all labor, materials, equipment, materials, necessary for furnishing and installing completed new junction boxes and manholes as shown in the Drawings and as specified herein. This item shall include, but not necessarily be limited to excavation and backfill, surface restoration, coating, cones, bases, rings and covers, manhole ring, manhole rubber joint seal, mortar, saws cutting of surfaces, testing, inspection, and all other work incidentals to furnishing and installing a completed junction box and manhole.

B. Payment for that portion of a Standard pre-cast manhole with pre-cast base, drop manhole with pre-cast base, special manhole, centered tee manhole, or tangent tee manhole in excess of eight (8) feet in depth will be made at the unit price of extra depth manholes paid for at the unit price bid per vertical foot of the indicated type and size complete in place.

END OF SECTION

SECTION 03210

FRAMES, GRATES, RINGS, AND COVERS

PART 1 - G E N E R A L

1.1 SCOPE

A. This item shall govern furnishing and installation of frames, grates, rings and covers for inlets, manholes and other structures indicated on the Drawings.

1.2 RELATED SECTIONS

A. Section 01500, Concrete for Structures

1.3 REFERENCE STANDARDS

A. Current Texas Commission on Environmental Quality (TCEQ) rules and American Water Works Association (AWWA) standards relating to manholes and sewer collection systems.

1.4 SUBMITTALS

A. Shop Drawings

1. Submit Manufacturer's drawings for material to be supplied under this Section. Indicate model number, description, model number, painting requirements, and characteristics of frames, grates, rings, covers, height adjustment insert, and nuts and bolts to be installed.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Welded Steel

1. Welded steel grates and frames shall conform to the number, size, dimensions, and details indicated on the Drawings and shall be welded into an assembly in accordance with those details. Steel shall conform to the requirements of American Society for Testing and Materials (ASTM) A36/A36M.

B. Castings

1. Castings, whether Carbon-Steel, Gray Cast Iron or Ductile Iron shall conform to the shape and dimensions indicated on the Drawings and shall be clean substantial castings, free from sand or blowholes or other defects. Surfaces of the castings shall be free from burnt on sand and shall be reasonably smooth. Runners, risers, fins, and other cast on pieces shall be removed from the castings and such areas ground smooth. Bearing surfaces between manhole rings and covers or grates

and frames shall be cast or machined with such precision that uniform bearing shall be provided throughout the perimeter area of contact. Pairs of machined castings shall be matchmarked to facilitate subsequent identification at installation except for water and wastewater manhole and valve castings. These manhole and valve castings shall be fabricated with such draft, tolerances, bolt hole spacing, etc., that all rings and covers of a particular type or class are interchangeable and matchmarking will not be required.

2. Steel castings shall conform to ASTM A27/A27M. Grade 70-36 (480-250) shall be furnished unless otherwise specified on the Drawings.

3. Cast iron castings shall conform to ASTM A48.

4. Ductile Iron castings shall conform to ASTM A 536. Grade 60-40-18 (415-275-125) shall be used unless otherwise indicated on the Drawings.

C. Manhole Cover Riser Rings

1. Height-adjustment inserts for wastewater manhole rings, which are used for raising standard manhole covers, shall per the Details.

D. Nuts and Bolts

1. Nuts and bolts shall be hex head 5/8" x 2.5" #11 National Coarse Thread, Type 316 stainless steel. For bolted manhole covers, a thin film of an approved "Anti-freeze" compound, approved by the Engineer or designated representative, shall be applied to all bolts.

E. Mortar

1. Unless otherwise specified or approved by the Engineer or designated representative, the mortar for bedding castings shall consist of one (1) part Portland cement and three (3) parts sand and sufficient water to provide the desired consistency. The gradation of the fine aggregate shall meet the requirements for Grade No. 1 per the requirements of Section 01500, Concrete for Structures.

PART 3 – CONSTRUCTION METHODS

3.1 Frames, grates, rings and covers shall be constructed of the specified materials in accordance with the Drawings and Details.

3.2 All welding shall conform to the requirements of the ANSI/AWS Structural Welding Code D1.1. Welded frames, grates, rings and covers shall be given 1 coat of a commercial grade red lead oil paint and 2 coats of commercial grade aluminum paint. All coats shall be a minimum of 1.5 mils, dry.

PART 4 – MEASUREMENT AND PAYMENT

4.1 MEASUREMENT: Unless shown on the construction plans or called out within the Specifications as a pay item, frames, grates, rings and covers will not be measured. The quantities shown for these items or described are for informational purposes only.

4.2 PAYMENT: Unless specified as a pay item, frames, grates, rings and covers will not be paid for separately. Payment for furnishing all materials, tools, equipment, labor and

incidentals to complete the Work will be included in the Bid Items which constitute the complete structures.

END OF SECTION

SECTION 03220

BULKHEADS

PART 1 - G E N E R A L

1.1 SCOPE

A. The Work in this Section consists of furnishing all labor, materials, equipment, and incidentals for installing plywood or end caps as a temporary utility plug as. This Work will be placed in conjunction with installation of a sewer main where a continuation of the system will be performed later as shown in the Drawings.

1.2 RELATED SECTIONS

A. Section 01230, Excavation and Backfill

B. Section 01500, Concrete for Structures

C. Section 03100, Sanitary Sewer Main

1.3 SUBMITTALS

A. Provide Manufacturer's shop drawings and indicate material type (wood, plastic, rubber, etc.) f or the bulkheads.

B. Provide the bulkhead's application such as pipe characteristics and locations.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

PART 2 – P R O D U C T S

2.1 MATERIALS

A. Plywood shall be construction grade, ¾ inch thick and need not be new or treated.

B. End caps may be plastic, vitrified clay pipe, rubber, or concrete.

PART 3 – CONSTRUCTION METHODS

3.1 After installation of the utility requiring temporary bulkheading, an end cap or a section of plywood, having dimensions at least 6 inches more than the outside sewer main diameter shall be attached to the exposed bell or spigot and backfilled immediately after installation. Care shall be exercised to prevent the backfill material from entering the sewer main.

3.2 Bulkheads used with staged construction shall be sound, reasonably free of knots and warps and have a 3-inch nominal thickness.

PART 4 – MEASUREMENT AND PAYMENT

4.1 MEASUREMENT: Bulkheads will not to be measured separately but shall be considered subsidiary to the sanitary sewer main or sewer manholes.

4.2 PAYMENT: The labor, materials, and installation of bulkheads are not to be paid separately but shall be considered subsidiary to the sanitary sewer main or sewer manholes for which payment is made.

END OF SECTION

SECTION 03400
SANITARY SEWER MAIN TELEVISION INSPECTION

PART 1 – GENERAL

1.1 SCOPE

A. The Work covered by this Section consists of furnishing all labor, supervision, tools, equipment, materials, permits, and incidentals to televise, inspect, video, still photograph and document recording of sewer mains and manholes utilizing a color closed-circuit television (CCTV) inspection unit to evaluate the condition of the sewer infrastructure. All televised and recorded information shall be written to DVD video in a format specified by the Owner.

B. Televising may be observed by the Inspector, Engineer or Contractor as the camera is run through the system. All abnormalities, such as, but not limited to, misaligned joints, cracked/defected pipe, rolled gaskets, encrustations, mineral deposits, debris, shall be documented as part of the CCTV inspection.

C. Removal of all debris, solids, sand, grease, grit, rock, etc. from sewer mains, manholes, or structures to facilitate television inspection shall be included as part of this Work.

1.2 RELATED SECTIONS

A. Section 03100, Sanitary Sewer Main

B. Section 03120, Sewer Service Laterals

C. Section 03200, Sanitary Sewer Manholes

D. Section 03410, Sanitary Sewer Testing

1.3 REFERENCE STANDARDS

A. Texas Commission of Environmental Quality (TCEQ)

1. Chapter 213 Edwards Aquifer Recharge Zone
2. Chapter 217 Design Criteria for Domestic Wastewater Systems

1.4 SUBMITTALS

A. The Contractor shall provide a DVD and log of the televised system for review and approval by the Owner, Engineer and/or Inspector. DVDs must be in a format readable with standard viewing software such as Windows Media Player. If the Contractor provides a DVD of such poor quality that it cannot be properly evaluated, the Contractor shall re-televise as necessary at no additional cost to the Owner.

1. PACP Report and Top View Report for each section of pipe using NASSCO's PACP Standards unless otherwise instructed by the Engineer or Owner.

2. Separate line for each deficiency and location.

3. Corresponding video and location of each section of pipe and deficiencies on digital video.

B. The television unit shall also have the capability of displaying in color, on DVD, pipe inspection observations such as pipe defects, sags, points of intrusion, offset joints, service connection locations and any other relevant physical attributes. Each DVD shall be permanently labeled with the following:

1. Project name;

2. Date of television inspection;

3. Station to station location and size of sanitary sewer main;

4. Street and easement location;

5. Name of Contractor;

6. Date video submitted;

7. Video number;

8. Inspector's name.

C. The Contractor shall provide a line diagram area drawing and written log of findings for each DVD submitted. The drawing and written log shall include a description and location of the pipe segment televised, flow and camera direction, position of service connections, description and location of failures, overall pipe condition and weather conditions at the time of the CCTV inspection.

PART 2 - P R O D U C T S

2.1 QUALITY ASSURANCE

A. Equipment used shall be in good working order and provide continuous operation during TV/video inspection.

B. CD / DVD disks shall be of good visual quality capable of slow motion and pausing without significant reduction of visual quality.

C. Contractor must be NASSCO/PACP certified and certification number submitted to Owner and Engineer prior to commencement of Work.

D. Video image shall be calibrated using a Marconi Resolution Chart No. 1 or equivalent.

2.1 EQUIPMENT AND MATERIALS

A. Television Camera

1. The television inspection equipment shall have an accurate footage counter which displays on the monitor the exact distance of the camera from the center of the starting manhole.

2. Camera used shall be 360-degree COLOR RVC camera.

3. Camera shall be operative in 100% relative humidity and be specifically designed for the environment.

4. Camera shall have an integral lighting system capable of producing clearly focused, well-defined images of the entire periphery of the pipe.

5. The quality of video picture and definition provided shall be to the satisfaction of the Owner and Engineer and, if unsatisfactory, equipment shall be removed and replaced with satisfactory equipment.

6. The camera height shall be centered in the sewer main being televised.

7. The speed of the cameral shall not exceed 40 feet per minute.

B. Video Recording Equipment

1. Furnish video equipment to provide a visual and audio recording of all areas in the pipe. Video recording system at the site shall be capable of rewind, play back, slow motion and stop motion.

2. The video shall be recorded on a CD, DVD, or equal portable storage device whose format is compatible with Windows XP Pro. Also, an audio channel for clearly recording the camera locations and operator observations (cracks, leaks, service connections, etc.).

3. The system shall continuously indicate distance, in feet, from manhole to manhole and the manhole-to-manhole run numbers on the video recording.

C. Power Supply

1. Power supply shall be continuous. If night operations occur, supply all labor, power and lighting equipment for operations, traffic safety, permits, etc.

PART 3 - EXECUTION

3.1 GENERAL

A. New Mains: Recommended Cleaning

1. All mains and manholes should be clean of debris prior to televising. The sanitary sewer main shall be flushed within 72 hours of televising and recording. This will assure the main is clean of debris as well as identify any potential sags within the main.

2. All sanitary sewer gravity lines shall be televiewed at the Contractor's expense; and a video recording of the subject mains provided prior to preliminary acceptance and at the 1-year warranty inspection by the Owner. Televiewing may only occur after the stabilized subgrade has been installed and satisfactory density tests have been submitted to the Engineer. The Owner's authorized representative must be present during the televiewing, unless otherwise approved by the Owner. The sewer video inspection shall include rotating the camera lens to inspect the interior of each sewer lateral.

3. Demonstrate the ability of the televised and video equipment (camera/light/video/audio/photograph system) to the satisfaction of the Owner and Engineer. Distance meter shall be furnished on the digital video recording. Meter shall be checked using distances between manholes.

3.2 TELEVISING INSPECTION

A. Inspection shall be done one manhole section at a time.

B. Locate video vehicle on upstream side of manhole. Recording shall begin during the lowering of the camera into the manhole opening. Video in the downstream direction such that camera movement is with the flow. Camera lens shall be positioned looking along the axis of the sewer. The camera axis should be within ±10% of the vertical sewer centerline of the pipe. For oval shaped pipes, the camera shall be positioned vertically above the invert at a height ⅔ of the vertical dimension of the pipe.

C. Insert the camera in the upstream manhole after flow restrictions required have been accomplished. Flow into the system being inspected shall be stopped, except for service laterals into the system being inspected. Move camera through the pipelines at a moderate speed not exceeding 30 feet per minute. Excessive use of the pan and tilt features should be avoided. Stop camera at locations where one or more of the following conditions is observed:

1. Infiltration/inflow sources.
2. Service Laterals.
3. Structural defects including broken pipe; collapsed or collapsing pipe, cracks, deterioration, punctures, etc.
4. Abnormal joint conditions such as misalignments, open joints, and joints not sealed.
5. Unusual conditions such as root intrusion, protruding pipes, inline pipe size changes, mineral deposits, grease, and obstructions.

D. Stop camera long enough for a thorough visual inspection of the conditions. All such conditions as specified above, along with the corresponding the Pipeline Assessment and Certification Program (PACP) code for each condition, shall be audio recorded on video and the inspection log sheet. Move the camera and rotate to obtain optimum view of the conditions. Each condition should be framed as to provide a full perspective. If requested by an Owner's representative, view problem areas in the opposite direction by pulling the TV camera from the opposite direction at no additional cost to the Owner.

E. While the camera is stopped at each service connection, rotate the camera to be able to view the service connection for a length of time that enables a good visual inspection of the service connection for damage and infiltration. Be responsible for measurements such as service lateral locations, if used for subsequent rehabilitation work.

F. When, during the inspection operation, the television camera will not pass through the entire manhole-to-manhole section, set up equipment so that the

inspection can be performed from the opposite manhole at no additional cost to the Owner. All reasonable effort should be given to video the entire segment including the removal of obstructions, reversals, location and exposure of buried manholes, use of more versatile equipment, etc.

G. Any defects or anomalies detected on new construction that does not meet the Owner's requirements shall be corrected by the Contractor prior to the Owner and Engineer's acceptance. Once corrected, the portion(s) shall be videoed, again, to assure the modification(s) was made correctly.

3.3 CONSTRUCTION METHODS

A. The Contractor is required to have all material, equipment, and labor force on site prior to isolating the sewer manhole segment and beginning the inspection operations.

B. Clean sewer lines and manholes as needed to allow free travel of the camera.

C. Television inspection shall be done one section (between two manholes) at a time.

D. The internal pipe flow shall be bypassed if the line is in service, and the flow exceeds 25% of the internal pipe diameter. Flow can be reduced to allowable levels by performing bypass pumping, after a bypass plan has been submitted and approved.

E. The Contractor shall not be allowed to float the camera. If the camera is unable to move down the sewer pipe due to an inspection, the Contractor shall contact the Owner, Engineer and/or Inspector and clean the system as necessary to continue the inspection. If, the obstruction is due to a collapsed main or pipe deflection, televising shall be suspended, and payment shall be made based on the actual linear feet of main televised. The blockage shall be corrected by the Contractor at his expense, and the remaining televising of the sewer line shall continue. No additional payment shall be made for additional setups required due to obstructions encountered during televising.

F. In the event of accidental spill or overflow, immediately stop the discharge and take action to clean up and disinfect the spill. Promptly notify the Owner so that required reporting can be made to the Texas Commission on Environmental Quality (TCEQ) and the Environmental Protection Agency (EPA) by the Owner. In the event of accidental spill or overflow, the Contractor is responsible for any damages that may have occurred to public or private property including cleaning, disinfection, and other corrections to the satisfaction of the Engineer at no cost to the Owner.

G. The Contractor shall be responsible for any and all damage of the sanitary sewer mains that results directly from the television inspections, at the Contractor's expense.

3.4 MAINTENANCE OF TRAFFIC

A. Be responsible for all maintenance of traffic around work site. Contractor shall maintain traffic in accordance with all federal, state and local regulations. At no additional cost to the Owner, submit a Maintenance of Traffic Plan, for review and approval by the Engineer as necessary, prior to commencing Work. Obtain all necessary permits prior to commencing Work, at no additional cost to the Owner.

B. Maintenance of traffic shall also include construction and maintenance of any necessary detour facilities, furnishings, installing and maintaining of traffic control and safety devices during construction, control of dust, and any other special requirements for safe and expeditious movement of traffic around or through the work site.

C. Be responsible for coordination with all affected agencies when roadways will be closed, or traffic will be detoured. No detours or roadway closings shall be permitted unless specifically received approval from the Owner.

PART 4 – MEASUREMENT AND PAYMENT

4.1 MEASUREMENT: The quantity that is measured per linear feet for payment shall be done for post television inspection on the basis of unit price bid per linear foot of sanitary sewer main based on the diameter sizes described within the payment subsection. This Work shall include full compensation for all labor, materials, equipment, tools, logging, bypass pumping, settlement testing, cleaning, hauling materials, tools, debris disposal, inspection, and incidentals necessary to complete the Work.

4.2 PAYMENT: Payment shall be full compensation for all labor, materials, equipment tools, logging, cleaning by bypass pumping, and incidentals necessary to complete the Work based on the unit bid price per linear foot on the following pipe diameters:

- 8-inch through 15-inch
- 18-inch through 24-inch
- 27-inch and larger

A. No additional compensation shall be provided for all needed repairs, re-cleaning, or re-televising effort.

B. There will be no separate pay item for this Work for bypass pumping associated with this Work.

C. There will no separate pay item for ramps, steel plates, or other methods be employed by the Contractor to facilitate traffic over surface piping.

END OF SECTION

SECTION 03410
SANITARY SEWER TESTING

PART 1 – GENERAL

1.1 SCOPE

A. The Contractor shall furnish all labor, materials, equipment, appurtenances, and services to conduct the air, infiltration, exfiltration, and pipe deflection tests in accordance with these Specifications.

B. Where references are made to other standards or codes, unless specific date references are indicated, the latest edition of said standard or code shall govern.

1.2 REFERENCE STANDARDS

A. Texas Commission of Environmental Quality (TCEQ)

1. Chapter 217 – Design for Domestic Wastewater Systems

B. American Society for Testing and Materials (ASTM) International

1. ASTM C 828 – Standard Test Method for Low Pressure Air Test of Vitrified Clay Pipelines.
2. ASTM C 924 – Standard Practice for Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method.
3. ASTM D 3034 – Standard Specification for Type PSM Polyethylene (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
4. ASTM F 794 – Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.
5. ASTM F 1417 – Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low Pressure Air.
6. ASTM C 1244 Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill.

1.3 RELATED SECTIONS

A. Section 03100, Sanitary Sewer Main

B. Section 03200, Sanitary Sewer Manholes

C. Section 03400, Sanitary Sewer Main TV Inspection

1.4 SUBMITTALS

A. The contractor shall submit the Manufacturer's product data instructions, recommendations, shop drawings, and certifications.

B. Submit test plan before testing and in adequate timing to obtain approval by Engineer.

C. Include testing procedures, methods, equipment, and tentative schedule.

D. Obtain advance written approval for deviations from Drawings and Specifications.

E. Submit test reports for each test on each segment of sanitary sewer.

PART 2 – EXECUTION

Testing of Installed Pipe: The Contractor shall perform a low-pressure air test or an infiltration/exfiltration test, and for pipe installed by open cut method, a settlement test before installed Work shall be considered accepted. If a gravity collection main is composed of flexible pipe, a deflection test will be required. Flexible pipe is defined as pipe that will deflect at least 2% without structural distress. Contractor shall insure that all testing is performed in the presence of the Inspector, with copies of all written test results available to the Engineer and Inspector. The pipe shall be inspected with closed circuit television (CCTV) camera. The Contractor shall be solely responsible for making proper repairs to these elements which do not pass these test requirements.

2.1 EXFILTRATION TEST

A. Water for the Work shall be metered and furnished by the Contractor.

B. The main shall be filled with water for its complete length or by sections as determined by the Engineer. If tested for its complete length, the maximum head at any point shall not exceed 25 feet unless otherwise indicated. If tested in sections, the manholes in the test section shall be filled with water. After the main has been filled and allowed to stand for 24 hours, the amount of exfiltration shall be calculated. Any amount more than 200 gallons per inch of inside pipe diameter per mile per day shall be cause for rejection.

C. Portions of mains located within the Edwards Aquifer Recharge Zone or within any recharge area or recharge feature within the Edwards Aquifer Transition Zone, the minimum head during testing shall not be less than 2 feet and the leakage rate shall not exceed 50 gallons per inch of inside pipe diameter per mile per day. This rate shall apply for the entire portion of the main extending up to the first manhole located outside the recharge zone, recharge area, or recharge features indicated on Drawings and shall also be applicable for any recharge areas or recharge features which may be identified during construction.

D. Construction within the 25-year flood plain, the exfiltration rate shall not exceed 10 gallons per inch diameter per mile of main per 24 hours at the same minimum test head.

2.2 INFILTRATION TEST

A. When the main placed in easements is completed, the upper portion of the trench backfill shall be removed to a depth of not less than 18 inches below the finished surface and width equal to the original trench width. The trench shall then be flooded with water until it is completely saturated, and water stands in the ditch a minimum of 12 inches deep. In cases of steep terrain, earthen dikes shall be used to assure that water will stand over the trench. After it is apparent that the trench is completely saturated, the main shall then

be inspected with CCTV for infiltration. Any section of the main or any service stub that indicates infiltration above the maximum quantity specified shall be cause for rejection.

B. This procedure shall not be used for mains installed in areas where the Plasticity Index (P.I.) of the surrounding material is 20 or higher or where the backfill material has a P.I. of 20 or more.

C. Portions of mains located within the Edwards Aquifer Recharge Zone or within any recharge area or recharge feature within the Edwards Aquifer Transition Zone, the total infiltration as determined by water test, must be at a rate not greater than 50 gallons per inch of pipe diameter per mile of pipe per 24 hours at a minimum test head of two feet. This rate shall apply for the entire portion of the line extending up to the first manhole located outside the recharge zone, recharge area, or recharge features indicated on Drawings and shall also be applicable for any recharge areas or recharge features which may be identified during construction. Construction within the 25-year flood plain, the infiltration rate shall not exceed 10 gallons per inch diameter per mile of pipe per 24 hours at the same minimum test head.

D. If the quantity of infiltration exceeds the maximum quantity specified, remedial action must be undertaken to reduce the infiltration to an amount within the limits specified.

2.3 SETTLEMENT TEST

A. During the infiltration test or after the exfiltration test, the main will be TV inspected for possible settlement. When air testing has been used, water shall be flushed into the pipe to permit meaningful observations. Prior to flushing, the manholes and pipes should be cleared of all debris. Any pipe settlement which causes excessive ponding of water in the pipe shall be cause for rejection. Excessive ponding shall be defined as a golf ball (1-5/8" diameter) submerged at any point along the line.

2.4 LOW PRESSURE AIR TEST OF PLASTIC GRAVITY SEWER MAINS

A. General

1. Wastewater mains, at the discretion of the Engineer, shall be air tested between manholes. Backfilling to grade shall be completed before the test and all laterals and stubs shall be capped or plugged by the Contractor so as not to allow air losses, which could cause an erroneous, test result. Manholes shall be plugged so they are isolated from the pipe and cannot be included in the test.

2. All plugs used to close the sewer for the air test shall be capable of resisting the internal pressures and must be securely braced. Place all air testing equipment above ground and allow no one to enter a manhole or trench where a plugged sewer is under pressure. Release all pressure before the plugs are removed. The testing equipment used must include a pressure relief device designed to relieve pressure in the sewer under test at 10 psi or less and must allow continuous monitoring of the test pressures in order to avoid excessive pressure. Use care to avoid the flooding of the air inlet by infiltrated

ground water. (Inject the air at the upper plug if possible.) Use only qualified personnel to conduct the test.

B. Ground Water

1. Presence of ground water will affect the test results; test holes shall be dug to the pipe zone at intervals of not more than 100 feet and the average height of ground water above the pipe (if any) shall be determined before starting the test.

C. Test Procedure

1. The Engineer may, at any time, require a calibration check of the instrumentation used. Use a pressure gauge having minimum divisions of 0.10 psi and an accuracy of 0.0625 psi (one ounce per square inch.) All air used shall pass through a single control panel. Clean the sewer to be tested and remove all debris where indicated. Wet the sewer prior to testing. The average back pressure of any groundwater shall be determined (0.433 psi) for each foot of average water depth (if any) above the sewer.

2. Add air slowly to the section of sewer being tested until the internal air pressure is raised to 4.0 psig greater than the average back pressure of any ground water that may submerge the main. After the internal test pressure is reached, allow at least 2 minutes for the air temperature to stabilize, adding only the amount of air required to maintain pressure. After the temperature stabilization period, disconnect the air supply. Determine and record the time in seconds that is required for the internal air pressure to drop from 3.5 psig to 2.5 psig greater than the average backpressure of any ground water that may submerge the main. Compare the time recorded with the specification time for the size and length of pipe as given in the following table:

Table for Low Pressure Air Testing of Plastic Pipe:

Minimum Specified Time Required For 1.0 psig Pressure Drop For Size and Length of Pipe Indicated								
Diameter of Pipe, (in.)	Specification Time (min: sec) for length shown							
	100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33
27	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48
30	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15
33	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53
36	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46

NOTES: 1. Specification times are as given in UNI-B-6 RECOMMENDED PRACTICE FOR LOW-PRESSURE TESTING OF INSTALLED PIPE -- by Uni-Bell PVC Pipe Association, 2655 Villa Creek Dr.,Ste. 155, Dallas Texas 75234.

3. Any drop in pressure, from 3.5 psig to 2.5 psig (adjusted for groundwater level), in a time less than that required by the above table shall be cause for rejection. When the line tested includes more than one size pipe, the minimum time shall be that given for the largest size pipe included.

4. Test procedure for sewer main located in the Edwards Aquifer Recharge Zone or identified recharge areas or recharge features within the Edwards Aquifer Transition Zone:

   i. Low-pressure air tests must conform to the procedure described in ASTM C-924 or other equivalent procedures. For safety reasons, air testing of main sections will be limited to main sizes of 36 inches inside diameter or less. Mains that are 36 inches or larger inside diameter may be air tested at each joint. The minimum time allowable for the pressure to drop from 3.5 pounds per square inch to 2.5 pounds per square inch gauge during a joint test, regardless of main size, shall be twenty (20) seconds.

   ii. Sections of main less than 36-inch inside diameter, the minimum time allowable for the pressure to drop from 3.5 pounds per square inch gauge to 2.5 pounds per square inch gauge must be computed by the following equation:

   T = 0.0850 (D)(K)/(Q)

   T = time for pressure to drop 1.0 pounds per square inch gauge in seconds;

   K = 0.000419(D)(L), but not less than 1.0

   D = nominal inside diameter in inches;

   L = length of line of same pipe size in feet; and

   Q = rate of loss, assume 0.0015 cubic feet per minute per square foot (ft3/min/ft sq) of internal surface area.

   iii. Any drop in pressure, from 3.5 psig to 2.5 psig, in a time less than that required by the above formula shall be cause for rejection. When the line tested includes more than one size of pipe, the minimum time shall be that calculated for the largest size pipe included.

   iv. Manholes must be tested separately and independently. All manholes must be hydrostatically tested with a maximum loss allowance of 0.025 gallon per foot diameter per foot of head per hour.

v. When mains are air tested, manholes are to be tested separately by exfiltration or vacuum method in accordance with Section 3200 of these Specifications.

D. Deflection Test

i. Deflection tests shall be performed by the Contractor on all flexible and semi-rigid wastewater pipes based on the 30 TAC § 217 standards.

ii. The deflection test must be accurate to within +/- 0.2% deflection. The test shall be conducted after the final backfill has been in place at least 30 days. No pipe shall exceed a deflection of five percent. If a pipe should fail to pass the deflection test, a second test shall be conducted to rectify the errors and after the failed area's final backfill has been in place an additional 30 days. The tests shall be performed without mechanical pulling devices. Upon completion of construction, the Engineer shall certify to the Inspector that the entire installation has passed the deflection test. This certification may be in conjunction with the notice of completion required in 30 TAC § 217.14. This certification shall be provided for the Owner to consider the requirements of the approval have been met.

iii. Mandrel:

- Testing for in-place deflection shall be with a pipe mandrel or rigid ball sized at 95% of the inside diameter of the pipe.
- A second test of flexible and semi-rigid wastewater mains 18-inch size and larger, also with a main mandrel or ball sized at 95% of the inside diameter of the pipe, shall be conducted by the Contractor 30 days prior to expiration of his warranty on the Work.
- All mandrel dimensions shall be per appropriate standard. Statistical or other "tolerance packages" shall not be considered in mandrel sizing.
- The rigid mandrel shall be constructed of a metal or a rigid plastic material that can withstand 200 psi without being deformed. The mandrel shall have nine or more "runners" or "legs" as long as the total number is an odd number.
- The barrel section of the mandrel shall have at least 75% of the inside diameter of the pipe.
- A proving ring shall be provided and used for each size mandrel in sue.
- Contractor shall submit his proposed main mandrels or testing balls to the Engineer or Inspector for concurrence prior to testing the main.

- Test(s) must be performed without mechanical pulling devices and must be witnessed by the Engineer or Inspector.
- Any deficiencies noted shall be corrected by the Contractor and the test(s) shall be redone.

iv. Test Reports: Submit reports from tests in accordance with relevant standards.

PART 3 – MEASUREMENT AND PAYMENT

3.1 MEASUREMENT: Unless shown on the Drawings or called out within the Specifications as a pay item, the air, infiltration, exfiltration, and deflection testing quantities shown or described are for information purposes only. No separate measurement for these testing procedures will be made by the Contractor for this Work.

3.2 PAYMENT: Unless specified as a pay item, the air, infiltration, exfiltration, and deflection settlement testing will not be paid for directly but will be subsidiary to the pertinent items associated with construction activities. No separate payment will be made to the Contractor for this Work.

END OF SECTION

SECTION 03500
WASTEWATER DESIGN CRITERIA

PART 1 - GENERAL

The following information is intended to assist engineers and the general public in the design and construction of wastewater facilities. Information herein is to provide minimum Crystal Clear Special Utility District (CCSUD) requirements only. Sound engineering judgment shall be utilized to determine if these minimum requirementsare suitable for each engineering design.

1.1 CONSTRUCTION PLAN INFORMATION AND SUBMITTAL REQUIREMENTS

A. One (1) complete set of Civil Construction plans shall be submitted to CCSUD for verification of conformance to the CCSUD Standards and Specifications.

B. Plans submitted to CCSUD must show approved easements and/or permits on highway and/or railroad crossings.

C. All wastewater plans will include the following items:

1. Engineer's dated signature and seal of a Professional Engineer licensed in the State of Texas on each plan sheet.
2. Engineering firm name and registered number (format F-xxxxx) on each plan sheet.
3. Date of plans and revisions.
4. North arrow and scale must be shown. The standard horizontal scale for plan and profile sheets shall be 1" = 50', 40' or 20' for the plan view. The vertical scale shall be 1" = 5', 4' or 2'. The same scale shall be used on all plan and profile sheets. For sheets other than plan and profile, horizontal scales of 1" = 50', 40' or 20' may be used as appropriate.
5. A general location map.
6. Standard CCSUD Wastewater construction notes.
7. Volume and page number of recorded easement(s).
8. Size, pipe material and location of main with respect to the easements and rights-of-way.
9. Property lines and dimensions, legal description, lot and block numbers, rights-of-way dimensions, and curb and sidewalk locations and street names.
10. Location, size, and material of all existing water and wastewater mains, lines, and services. The direction of flow in the wastewater mains shall be indicated.
11. Location, size, and description of other utilities where they may conflict with water or wastewater mains or other service lines.
12. Curve data for roads, property lines, and water and wastewater lines.
13. Curves are not permitted on wastewater mains unless given written approval by the CCSUD Engineer.
14. Final plat recording or land status report.

D. Final plan approval may require additional authorizations.

1. Texas Department of Transportation permit

2. Railroad permit
3. Gas Company permit
4. Easement acquisition (Volume and Page listed on plans)
5. City approval
6. County approval
7. Texas Commission on Environmental Quality approval

1.2 WASTEWATER SYSTEM PLANS

A. All plan view drawings shall include all applicable items listed in the General Requirements mentioned above plus the following items.

1. Station numbers at all proposed connections to existing or proposed wastewater mains.
2. The location, alignment, and structural features of the wastewater main, including manholes and concrete retards, if applicable.
3. Station numbers for beginning points, ending points, manholes, clean- outs and other appurtenances.
4. Details of all required appurtenances.
5. Location of all existing and proposed wastewater services, mains, and manholes.
6. One hundred year flood plain limits.
7. Retaining walls, including geogrid, straps, tie-backs and all other components.
8. Culverts, bridges, and other drainage structures.

B. A profile view shall be provided for all wastewater mains and shall include all applicable items listed in the general requirements above plus the following items:

1. The existing ground profile and proposed street finish grade or subgrade or finished grade if not under pavement.
2. Station numbers and elevations of all utility crossings.
3. Identify the pipe size, percent grade, and pipe material to be used including ASTM and/or AWWA designation. If an alternate material is to be allowed, both should be listed (example “DI or PVC”).
4. Station numbers and elevations for starting points, ending points, manholes, wastewater service lines, clean-outs, and at intermediate points every 100 feet.
5. Elevations shall be indicated on the profile showing the finish floor elevations of all existing structures. If the structure has an active septic tank or other disposal system, the flow line elevation of the plumbing where it exits from the structure is to be indicated. If a lot or tract is vacant, side shots may be required from the middle of each lot to ensure gravity service is possible from the lot to the main.
6. Design flows, minimum and maximum, and flow velocities at minimum and maximum dry weather flows.
7. Retaining walls, including geogrid, straps, tie-backs and all other components.
8. Culverts, bridges, and other drainage structures.

(NOTE: Plan Approval shall expire one year from the date of current approval. If construction has not begun on the facility within one year of the approval date, plans must be resubmitted for approval and must include all criteria in effect at the time resubmitted.)

1.3 LIFT STATION REVIEW, APPROVAL AND ACCEPTANCE

A. Engineering Report, Plans and Specifications Review and Approval

(NOTE: Plan Approval shall expire one year from the date of approval. If construction has not begun on the facility within one year of the approval date, plans must be resubmitted for approval and must include all criteria in effect at the time resubmitted.)

1. Prior to design two (2) copies of a detailed engineering report shall be submitted to CCSUD for review and approval of the lift station and all related line work. The engineering report shall include the following:
   a) Justification for the proposed lift station. The report must clearly show that gravity lines are not available and are not economically feasible and that the number of lift stations has been minimized. This justification must include a cost benefit analysis of gravity versus lift station project including 30 years of operation and maintenance of the proposed system.
   b) A master development plan for the service area of the proposed lift station shall be prepared. This plan shall include a map showing the location of the lift station, the service area, the boundaries of the drainage basin it is in and the location of the nearest existing wastewater interceptor within or outside of that basin.
   c) Engineering calculations and data described in Sections 2.2.A and 2.2.H shall be contained in the engineering report.
   d) The Engineering Report shall be approved by CCSUD prior to beginning preparation of the plans and specifications.
2. Prior to construction two (2) complete sets of the Civil Construction plans and specifications shall be submitted to the CCSUD for review and approval. These plans and specifications shall be prepared, sealed, signed, and dated by a Professional Engineer licensed to practice in Texas and shall be in compliance with the approved Engineering Report. The plans and specifications for the lift station shall also include all related line work and a comprehensive site plan including any required access road(s) and easement(s).
3. All plans and specifications for lift stations to be served by CCSUD , submitted for review and approval, must demonstrate compliance with current CCSUD Design Criteria and Standard Specifications. Approval of the lift station plans and specifications does not imply CCSUD will accept the lift station for operation and maintenance (Refer to Section 3.3).
   a) Within the CCSUD Service Area the following type of Lift Stations may be submitted for review and approval:
      1) Submersible pump facilities with mechanical redundancy for duplex, triplex, and quadplex operations.

B. Submittal and Shop Drawing Review

Once the engineering report, plans and specifications have been approved, submittals and shop drawings shall be provided to CCSUD per Specification Section 00500 - Submittals. These submittals shall contain complete detailed information and drawings for all lift station equipment and components.

C. CCSUD Operation and Maintenance Acceptance

CCSUD may accept a lift station with a firm pumping capacity greater than 120 gpm for operation and maintenance provided the following conditions are met:

1. CCSUD has inspected the lift station and determined that it is constructed in conformance to CCSUD's requirements. Any lift station not conforming to CCSUD standards shall be upgraded to CCSUD standards before CCSUD will accept the lift stations for operation and maintenance.
2. The owner or his representative has provided all information requested in Sections 3.1 and 3.2 above, two (2) complete hardcopy sets and one (1) electronic copy of all Operations and Maintenance Manuals for all equipment installed and has received CCSUD's approval.
3. The owner has granted CCSUD a wastewater easement for the lift station and access road. A copy of the recorded easement plat, legal description and any other legal documents granting the easement shall be delivered to CCSUD. The easement shall extend to at least five (5) feet outside the lift station fence and shall include access road with turn-around areas that extend back to paved public rights-of-way. This easement shall be separate and in addition to any necessary pipeline easement.
4. If the lift station is to become a permanent installation, transfer of ownership and title to the land may be required by CCSUD prior to acceptance of the station for operation and maintenance.
5. A letter of assignment has been written to CCSUD from the owner transferring title of the lift station and related equipment to CCSUD. This letter shall be delivered to CCSUD before acceptance of the lift station for operation and maintenance. The original owner may regain title to a temporary lift station that was designed and constructed entirely at his expense and for which no refund was made by CCSUD. After written notification by CCSUD that the lift station has been abandoned, the original owner has one (1) month to notify CCSUD in writing of his intent to regain title to the temporary lift station site.
6. One (1) complete set of Record Drawings shall be provided to CCSUD in paper and digital format prior to acceptance of the lift station for operation and maintenance.

PART 2 - DESIGN REQUIREMENTS FOR WASTEWATER SYSTEMS

2.1 INTRODUCTION

These guidelines are intended to establish the minimum basic design requirements for wastewater systems served by CCSUD, but do not address major facilities such as wastewater treatment plants. Generally, these systems will be operated and maintained by CCSUD.

All project manuals shall include the appropriate CCSUD Standard Specifications. All projects are required to be built in accordance with these CCSUD Standard Specifications, which may include other requirements not addressed here. All variations are subject to the approval of CCSUD. Additional requirements for specific projects may be established where the conditions ofservice to the tract and related system operation and maintenance needs warrant.

The following information is provided to assist engineers and the general public in the design and construction of water and wastewater facilities within the CCSUD service area. All plans for such facilities shall be prepared by or under the supervision of a Professional Engineer, licensed in the State of Texas. It will be the responsibility of the engineer to ensure that the plans are in compliance with the latest versions of all applicable federal, state, and local ordinances, rules, and regulations.

These include, but are not limited to, the following:

A. Design Criteria for Sewage Systems – Texas Commission on Environmental Quality (TCEQ)
B. CCSUD Standard Specifications and Details
C. CCSUD Wastewater Design Criteria
D. CCSUD Electrical Design Criteria

2.2 WASTEWATER SYSTEMS

A. Determination of Wastewater Flow

1. Residential single-family units shall be assumed to produce an average wastewater flow of 225 gallons/day. When designing lift stations, assume 325 gallons/day.
2. Industrial wastewater flows will be evaluated on a case-by-case basis.
3. Inflow/Infiltration.

   In sizing wastewater lines, external contributions are accounted for by including 750 gallons per acre per day served for inflow and infiltration. For wastewater lines in the Edwards Aquifer Zone refer to the Texas Commission on Environmental Quality requirements. Strict attention shall be given to minimizing inflow and infiltration.
4. Peak Dry Weather Flow.

   The peak dry weather flow is derived from the formula:

$$Q_{pd} = \frac{[18+(0.0206 \times F)^{0.5}]}{[4+(0.0206 \times F)^{0.5}]} \times F$$

where:

$$F = \frac{225(\text{gal/LUE/day}) \times (\#\ \text{LUE})}{1440}$$

F = average dry-weather flow in gpm

5. Peak Wet Weather Flow.

   The peak wet weather flow is obtained by adding inflow and infiltrationto the peak dry weather flow. In designing for an existing facility, flow measurement shall be used in lieu of calculations for the pre-existing developed area.
6. Minimum Flow.

The minimum flow is derived from the formula:

$$Q_{min} = [0.2 \times (0.0144 \times F)^{0.198}] \times F$$

B. Determination of Pipe Size

1. Minimum Size.

   The minimum diameter of all gravity wastewater mains shall be eight (8) inches. For service line sizes, refer to the CCSUD Standard Details.

2. Design Requirements.

   For wastewater mains, fifteen (15) inches in diameter or smaller, use the larger size as determined below:

a. The main shall be designed such that the Peak Dry Weather Flow shall not exceed 65% of the capacity of the pipe flowing full.

b. The main shall be designed such that the Peak Wet Weather Flow shall not exceed 85% of the capacity of the pipe flowing full.

   For wastewater mains, eighteen (18) inches in diameter or larger, the main shall be designed such that the Peak Wet Weather Flow shallnot exceed 80% of the capacity of the pipe flowing full.

3. Design Velocities.

   The minimum design velocity calculated using the Peak Dry Weather Flow shall not be less than two (2) feet per second (fps). The maximum design velocity calculated using the Peak Wet Weather Flow should not exceed ten (10) fps. Velocities in excess of 10 fps may be considered under special conditions where no other options are available. In such cases, proper consideration shall be given to pipe material, abrasive characteristics of the wastewater flows, turbulence and displacement by erosion or shock.

4. Minimum Slope.

   Minimum allowable slope for mains shall conform with the Texas Commission on Environmental Quality standards. (see table below)

Sizes of PipeIn Inches I.D.	Minimum SlopeIn Percent	Maximum SlopeIn Percent
6	0.50	12.35
8	0.34	8.40
10	0.25	6.23
12	0.20	4.88
15	0.15	3.62
18	0.12	2.83
21	0.10	2.30
24	0.08	1.93
27	0.07	1.65
30	0.06	1.43
33	0.055	1.26
36	0.045	1.12
39	0.04	1.01
>39	Calculate	Calculate

C. Design Considerations

1. Materials and Standards.

   All materials and appurtenances shall conform to the CCSUD Approved Equipment List.

2. Protecting Public Water Supply.

   No physical connection shall be made between a drinking water supply and a wastewater pipe or any appurtenance thereof. An air gap of a minimum of two inlet pipe diameters between the potable water supply and the overflow level connected to the wastewater pipe shall beprovided.

3. Location.

   The location of the wastewater main shall be in conformance with the CCSUD Standard Details (location shall be center of street). Alternative assignments must be approved by CCSUD.

4. Separation Distance.

   The separation between wastewater mains and other utilities shall be in accordance with the Rules adopted by the Texas Commission on Environmental Quality.

5. Steep grades.

   Where the pipe grade exceeds 12 percent and the construction is outside of any pavement, concrete retards conforming to the CCSUD standards will be required at intervals of no more than 25 feet (preferably at joint locations).

6. Depth of Cover.

   The minimum depth of cover over the upper-most projection of the main shall be 36 inches. Add concrete cap or encasement if cover is less than 36 inches; the maximum depth shall be as approved by CCSUD for the specific material, application, and conditions.

7. Turbulence.

   Wastewater lines shall be designed to minimize turbulence to prevent release of sulfide gases and subsequent corrosion.

D. Manholes

All manhole ring and covers shall have ring covers locked into place by a one (1) foot wide concrete collar per Standard Detail Drawing No. 329. All manholes shall be constructed so that the top of the ring is two inches (2") above surrounding ground except when located in paved area. In paved areas, the manhole ring shall be flush with pavement.

1. Location.

   Manholes shall be located and spaced to facilitate inspection and maintenance of the wastewater main. Manholes shall be placed at the following locations:

   a. Intersections of mains.
   b. Horizontal alignment changes.
   c. Vertical grade changes.
   d. Change of pipe size.
   e. Change of pipe material.
   f. The point of discharge of a force main into a gravity wastewatermain.
   g. Intersection of service lines to main lines 24 inches and larger.
   h. A manhole is required at the point of connection of a building service line to the public wastewater service stub for multi-family projects exceeding fifteen (15) dwelling units and for commercial developments with use of a

2" domestic meter or larger.

2. Spacing.

   Manhole spacing for lines smaller than 24 inches should not exceed 500 ft.; for larger mains, spacing may be increased, subject to approval by CCSUD in writing.

3. Covers.

   All manholes not located in paved areas, or those residing in drainage ways shall have bolted, watertight covers. Where watertight manhole covers are used, every third manhole will be vented and equipped with manhole rain infiltration inserts.

4. Corrosion Prevention.

   Manholes shall be constructed of or lined with a corrosion resistant material. Where new construction ties into an existing manhole, the existing manholes must be lined, coated, or replaced with a corrosion resistant material.

5. All lines into manholes, including drop connections, shall match crown- to-crown where feasible. Any deviation must be approved in advance by CCSUD in writing.

6. Drop manholes will have a maximum of 8' of drop and are not allowed where main size exceeds 15". The minimum distance before requiring a drop pipe is 2' of drop.

7. Manholes shall have the following minimum sizing:
   a) 48" for mains up to 18" in diameter
   b) 60" for 24" mains
   c) 72" for 30" and 36" mains
   d) 84" diameter for mains 48" and larger.
   e) Box manholes are acceptable for mains larger than 30"

E. Ventilation

Ventilation shall be provided as required by TCEQ Rules and Regulations.

F. Inverted Siphons

When justified and approved by CCSUD in writing, siphons shall have a minimum of two barrels. The minimum pipe size shall be eight (8) inches with a minimum flow velocity of 3.0 fps at peak dry weather flow. The minimum dry weather flow shall be used to size the smallest barrel. Three- barrel siphons shall be designed to carry the capacity of the incoming gravity wastewater mains(s) with one barrel out of service.

An additional corrosion resistant pipe shall be designed to allow for the free flow of air between the inlet and outlet siphon boxes. The diameter of this air jumper shall not be smaller than one-half the diameter of the upstream wastewater pipe. Air jumper pipe design shall provide for removal ofcondensate water that will collect in the pipe.

Siphon inlet and outlet structures shall be manufactured with approved corrosion resistant material and shall provide for siphon cleaning and maintenance requirements.

G. Service Lines

1. Wastewater service lines, between the main and property line, shall have an

inside diameter not less than six (6) inches. The minimum grade allowed for service lines is two (2) percent. In all new systems, grade breaks exceeding allowable joint deflection must be made with approved fittings and shall not exceed a cumulative total of 45 degrees. No service connections shall be made to mains larger than 15" in diameter.

2. Usually, wastewater services are placed at the center of a lot. Services to lots will terminate at the property line with a cleanout or will extend four (4) feet past the underground electric conduit if electric is installed in the front easement. Services should have a minimum of thirty-six (36) inches of cover. Cleanout shall be installed at the property line. All sewer cleanouts that lead to CCSUD mains shall be installed with a protective utility shroud and pivoting marker pole during time of construction.

3. Service to lots having a water/wastewater easement will terminate within the easement. For details, see the CCSUD Standard Details.

H. Lift Stations (Excluding low pressure systems)

Lift stations are discouraged and will be allowed only where conventional gravity service is not feasible (Lift Station installation cost plus 30 years O&M expense is less than installation cost for gravity system). This subsection details the specific design criteria for wastewater lift stations. Additional requirements for individual lift stations may be imposed by CCSUD as conditions warrant.

In addition to these criteria, all lift stations must meet the Texas Commission on Environmental Quality Chapter 217 rules and the CCSUD Design Criteria and Standard Specifications.

1. Flow Development

   Calculation of wastewater flow shall be done in accordance with Section 2.2.A. The following calculations shall be included.

   a. Maximum Wet Weather Flow (Design Flow)

      This flow is used to determine the lift station design capacity. All lift stations shall be designed to handle the maximum wet weather flow for its service area.

      Equation:

      (Population of service area × 100 gallons per capita per day (gpcd) × maximum flow peaking factor) + (750 gallons per day) × (number of acres).

   b. Maximum Dry Weather Flow

      This flow is used to determine pipe size in the collection system. Equation:

      (Population of service area) × (100 gpcd) × (maximum flow peaking factor)

   c. Average Dry Weather Flow

      This is the flow developed without the maximum flow peaking factor. This flow is used to determine the average detention time in the wet well.

      Equation

      (Population of service area) × (100 gpcd)

d. Minimum Dry Weather Flow

This is used to determine the maximum detention time in the wetwell.

Equation

(Population of service area) × (100 gpcd) × (minimum flow peaking factor)

e. A minimum of two (2) pumps shall be required for all lift stations. The capacity of the pumps shall be such that the maximum wet weather flow can be handled with the largest pump out of service.

2. Wet Well Design

a. Wet wells shall be round, precast concrete. Fiberglass wet wells will not be accepted.

b. Wet wells shall have epoxy spray-in coatings.

c. All guide rails, brackets, anchors, and supports shall be 316SS.

d. Full length 316SS lifting chains shall be provided for each pump.

e. The bottom of the wet well shall have a minimum slope to the intake of two (2) vertical to one (1) horizontal. There shall be no projections in the wet well, which would allow deposition of solids.

f. The wet well volume shall be sized to provide adequate storage volume at peak design flows and a pump cycle time of sufficient duration to prevent pump short cycling and consequential motor damage. Pump cycle time, defined as the sum of "pump off" time plus "pump on" time, shall be as follows:

Motor H.P.	Minimum Cycle Time in Minutes (t_c)
2 to 50	10
51 to 75	15
76 to 250	30
251 to 1500	45

Volume between "pump on" and "pump off" elevation (of the pump cycle) shall be determined by the following criteria:

$$V = (t_c/4) \times q$$

where q = pump capacity in gpm

g. All "pump on" levels shall have a minimum separation of one (1) foot between levels. All "pump off" levels shall be at least six (6) inches above the top of the pump casing. For more than two (2) pumps, the "pump off" levels shall be staged with a minimum separation of one (1) foot between levels.

h. An example of a two (2) pump staging sequence follows:

1) High level alarm
2) Lag pump on
3) Lead pump on
4) Lag pump off

5) Lead pump off

6) Low level alarm

The high level alarm shall be at least one foot above the last (highest) "pump on" level in the wet well and also at least one (1) footbelow the flowline of the lowest influent line into the wet well.

3. Wet Well Detention Time

   a. Calculate the detention time (Td) in the wet well for the maximum wet weather flow, maximum dry weather flow and average dry weather flow using the following equation:

$$T_d = t_f + t_e$$

Where:

t_f = (v) ÷ (i) = time to fill the wet well in minutes

t_e = (v) ÷ (q - i) = time to empty the wet well in minutes

V = volume of wet well between "pump on" and "pump off" elevations in gallons

q = Pump capacity in gpm

i = flow into the station corresponding to the maximum wet weather flow, maximum dry weather flow or average dry weather flow in gpm.

   b. Maximum detention time shall be calculated with i = minimum dry weather flow.

   c. Odor control shall be provided for the wet well if the total detention time in the wet well and force main system exceeds 180 minutes.

4. Static Head

   The static head shall be calculated for "pump on" and "pump off" elevations in the wet well.

5. Net Positive Suction Head

   The net positive suction head (NPSH) required by the pump selected shall be compared with the NPSH available in the system at the eye of the impeller. The engineer shall consult the pump manufacturer for the NPSH required values for that pump and compare them with calculated values for the NPSH available. The NPSH available should be greater than the NPSH required for selected pump. The following equation maybe used for calculating the NPSH available:

$$NPSH_A = P_B + H_s - P_v - H_{fs}$$

Where: P_B = barometric pressure in feet absolute,

H_s = minimum static suction head in feet,

P_v = vapor pressure of liquid in feet absolute,

H_{fs} = friction loss in suction in feet.

For lift stations in CCSUD's service area a barometric pressure of 33.4 feet may be used and a vapor pressure of one and four-tenths (1.4) feet may be used. These values are based on the following assumptions: an altitude of 500 feet above sea level, a water temperature of 85ºF and a specific gravity

of water of 0.996 at 85ºF.

6. Suction Piping Design
   a. All suction piping shall be flanged ductile iron and have a minimum diameter of four (4) inches. Each pump shall have a separate suction pipe.
   b. Suction piping shall have a velocity of three (3) to five (5) fps.
   c. All suction pipes inside the wet well shall be equipped with a flare type, down-turned intake. The distance between the bottom of the flare and the floor of the wet well shall be between D/3 and D/2 where D is the diameter of the flare inlet.
7. Discharge Piping
   a. CCSUD prefers above-grade over concrete slab. Will accept below grade vault if necessary due to location within a subdivision.
   b. Valve pad piping shall be epoxy lined flanged ductile iron.
   c. Provide an emergency bypass pumping port at lift station valve pad with check valve, plug valve, and aluminum female camlock with plug. Size to match pump discharge flange.
8. Force Main Design
   a. All force mains shall be ductile iron with non-corrosive lining, PVC class 160 or an approved HDPE with a minimum diameter of four (4) inches. Force main pipe within the station shall be flanged. Flexible fittings shall be provided at the exit wall.
   b. Force mains shall be sized so that the flow velocity is between three(3.0) and six (6.0) feet per second at ultimate development. During initial development phases, flow velocities may be as low as two and one-half (2.5) feet per second.
   c. The maximum time required to flush the force main shall be calculated based on average dry weather flow. Flush time shall be calculated for average dry weather flow using the following equations:

$$T_{flush} = (t_f + t_e) \times \frac{\text{(Force Main Length)}}{(t_{c/2}) \times (V_{fm}) \times (60 \text{ sec/min})}$$

Where:

t_e = Time to empty wet well in minutes
t_f = Time to fill wet well in minutes
V_{fm} = Flow velocity in the force main in feet per second
t_c = Pump cycle time in minutes

$$*t_e = \frac{V}{q - i}$$

$$*t_f = \frac{V}{i}$$

i = average dry weather flow in gpm

*See Section 2.2.H.3.a, "Wet Well Detention Time", for an explanation of V and q.

d. Odor and corrosion control shall be provided for the force main if theforce main detention time exceeds 30 minutes if dual force mains are not feasible.

e. Location and size of all air release valves shall be evaluated for odor or nuisance potential to adjacent property by the design engineer.

The use of air release valves shall be restricted to installations where there are not possible alternatives.

f. Sulfide Generation Potential.

Lift station/force main systems shall be evaluated for their sulfide generation potential and their ability to achieve scouring velocities during average dry weather flow periods. If the evaluation indicates that sulfide concentration of greater than 2 ppm and solids deposition are likely, the design shall:

1) define a workable sulfide control technique that will minimize sulfide formation in the force main,
2) include “pig” launching stations and recovery points to allow cleaning of the force main, and
3) protect the gravity main and manholes downstream of the forcemain from corrosion. The length of pipe to be protected shall be determined on a case-by-case basis.

g. Thrust restraint when required shall be shown on the plan view.

9. Head Loss Curves

a. Data points for the system capacity curve shall be provided in tabular form and graphed with pump head capacity curve on the same graph. Two system capacity curves shall be plotted using the Hazen Williams coefficient values of C = 100 and C= 140.

b. Pump output in gpm at maximum and minimum head shall be clearly shown on the system curve for each pump and combination of pumps.

c. For stations with two (2) or more pumps operating in parallel, multiple, and single operation points shall be plotted on the system curve.

d. Pumps with the highest efficiencies at all operating points shall be used.

e. If pumps are equipped with smaller impellers during start up to handle lower than design flows, impellers sized to handle the designflow shall also be provided.

10. Buoyancy Calculations

The lift station design shall include a complete analysis of buoyant forces on the entire lift station structure.

11. Water Hammer

a. Calculations for water hammer showing maximum pressures, which would occur upon total power failure while pumping, shall be provided using the following equations.

$$p = \frac{a \times v}{2.31 \times g} + \text{operating pressure of pipe (psi)}$$

$$a = \frac{12}{\{(w/g) \times [(1/k) + (d/(E \times t))]\}^{0.5}}$$

where:

p = water hammer pressure (psi)
a = pressure wave velocity (ft/s)
w = specific weight of water (62.4 lb./ft^3)
g = acceleration of gravity (32.2 ft/s^2)
k = bulk modulus of water (300,000 psi)
d = inside diameter of pipe (in)
E = Young's modulus of pipe (psi)
t = pipe wall thickness (in)
v = flow velocity in pipe (ft/s)
L = length of force main (ft)

Surge control measures shall be provided when pressures,including those due to water hammer, exceed the pressure rating of

the pipe.

12. Suction Specific Speed

Suction specific speed of the pumps shall be calculated using thefollowing formula:

$$SSS = R\ (Q)^{0.5} / (H)^{0.75}$$

where: SSS = suction specific speed (rpm)
Q = flow at the best efficiency point, gallons per minute (gpm)
H= net positive suction head required at maximumimpeller speed (feet)
R= speed of pump and motor in rpm

Suction specific speed should be below 9,000 rpm to ensure that the pump will not cavitate because of internal recirculation.

13. Energy Calculations

Energy costs shall be calculated using the following equations:

a. Calculate the water horsepower required.

$$P = \frac{(Q)(h)(8.34\ \text{lb/gal})}{33{,}000\ \text{ft-lb min/hp}}$$

where:

P = water horsepower (hp)
Q = flow, gallons per minute (gpm)
h = head, feet (ft)

b. Calculate the brake horsepower required.

$$Bhp = \frac{P}{\text{pump efficiency*}}$$

where: Bhp = brake horsepower (hp)
P = water horsepower (hp)

* Use the most efficient pumps for the application.

c. Calculate the electrical horsepower required

$$Ehp = \frac{Bhp}{\text{motor efficiency}}$$

where: Ehp = electrical horsepower (hp)
Bhp = brake horsepower (hp)

Use the most efficient motors for the application

d. Calculate the power required in kilowatts.

$$EkW = (Ehp)(0.746\ Kw/hp)$$

e. Calculate daily power consumption in kilowatt-hours.

$$E = [(EKW_1)(t_1) + (EkW_2)(t_2) + (EkW_3)(t_3)\ldots]$$

where: E = total power consumption, kilowatt hours(kWh) per day
EkW_n = power required, kilowatts for pumps 1,2,...,nt_n
= estimated pump run time in hours per day for pumps 1,2,...,n

f. Calculate the estimated cost for power consumption over the life ofthe station.

$$C = (E)(\$0.06/kWh)(T)$$

where:

C = cost of power over the life of the station (dollars)
E = power consumption (kilowatt-hour per day – kWh/day)
T = time the station is expected to be in service (days)

g. Stress and thrust calculations for internal station piping and bendsshall be provided for stations with flows over 1000 gpm.

14. Specific Station Requirements

a. Pumps shall be ABS, Flygt, or KSB; substitutions are not allowed. Grinder pumps are not allowed. Each pump shall be equipped with a mix/flush valve or equivalent mixing device. Provide full length 316SS lifting chains and chain grip eye. Pumps shall have minimum 4" diameter suction and discharge openings. Provide non-clogging impellers. Lift station design

and pump selection shall incorporate the future ability to increase impeller one size without changing pump bases, motors, electrical, or controls. Pumping systems shall be selected based on maximum wire-to-water efficiency. Field draw down testing is required to demonstrate the specified flow rate for each pump.

b. Guide rails with intermediate brackets, hoists, and hatches are required for stand-alone mixers. Materials of construction, components, and accessories shall be the same as for pumps.

c. All guide rails, brackets, anchors, and supports shall be 316SS.

d. All motors shall be Premium Efficiency with minimum 1.15 service factor. All motors driven by variable frequency drives shall be inverter-duty rated.

e. All equipment shall be designed to automatically reset after power outages.

f. All equipment shall have elapsed time meters.

g. Every lift station shall be equipped with an equipment lifting device. All components shall be corrosion resistant.

h. Wet wells and manholes shall be precast concrete. The interior of the structures shall be lined with SewperCoat, Refratta HAC 100, or approved equal calcium aluminate material. Proposed substitutes must be equal in composition and manufacturer warranty. Product must be installed by a manufacturer certified applicator. Prepare surface by sand blasting. Provide smooth trowel finish. Apply spray curing compound. Minimum thickness for manholes shall be ½". Minimum thickness for wet wells shall be 1".

i. The first riser and floor of the wet well shall be pre-cast integrally. Where this is not feasible, Adeka P-201 waterstop shall be used to seal the walls to a cast-in-place floor slab. Provide rubber O-ring gaskets at all riser joints.

j. All exposed vertical and horizontal concrete edges shall be formed with ¾" chamfer strips.

k. All equipment, piping, and valves shall be labeled for identification purposes (e.g. pipe labels, color coding, banding, flow arrows, equipment numbers, valve tags, etc.).

l. Provide color coded tracing wire (copper clad steel, 12 gauge, 30 mil HDPE jacket) for all buried piping.

m. Valve boxes, equipment, exposed piping and valves, and appurtenances shall be painted. Provide colors in accordance with TCEQ rules. Do not paint stainless steel, hot dip galvanized, brass, or aluminum items.

n. Lift station wet well and valve pad piping shall be epoxy lined flanged ductile iron. Wet well piping shall be coated with minimum two (2) coats of coal tar epoxy. Paint for valve pad piping and valves shall be white color high-build epoxy with topcoat of polyurethane in Grey Pantone #431-U color. Do not paint stainless steel, hot dip galvanized, brass, or aluminum items. Install in accordance with manufacturer recommendations.

o. Gate valves are not allowed for wastewater use. Isolation valves shall be round port plug valves with horizontal shaft closing downward by Crispin,

GA, Milliken, or Pratt. Plug valves, and check valves shall have 316SS external bolts, nuts, fasteners, and hardware. Valve assembly shall be installed above ground on concrete slab/pad.

p. Flange coupling adapters shall be Smith Blair Model 911. Flange adapters are not allowed within hydraulic structures.

q. Provide an emergency bypass pumping port at lift station valve pad with check valve, plug valve, and aluminum female camlock with plug. Size to match pump discharge flange.

r. All influent lines penetrating the wet well walls shall be shown in both plan view and sections. Seal wall penetrations with PSX direct drive boots, or GBRA approved equal, and non-shrink grout.

s. Wet wells shall have 4" minimum cast-in-place 316SS gooseneck vents with welded waterstop rings on pipe at penetrations. Provide flanged 316SS screens located 24" above top of roof slab.

t. Wet well hatch assemblies shall be aluminum with frames, safety grates, and covers rated for 300 PSF live load. Entrance hatches larger than 40 inches in diameter shall be spring loaded. Covers shall be equipped with padlock staples. Hardware, fasteners, and hinges shall be 316SS. Hatch assemblies shall be EJ Safe Hatch, or GBRA approved equal. Provide 2ea hatch keys.

u. All fasteners shall be Type 316 stainless steel (e.g. hardware, screws, anchor bolts, rods, bolts, nuts, etc. for piping, valves, pumps, motors, equipment, etc.) including those for factory assembly of components. All bolts and nuts shall be heavy hex. Anchor bolts installed within hydraulic structures shall be epoxy type. Field apply nickel anti-seize compound to threads prior to assembly. Stainless steel items shall not be painted.

v. All exposed piping 4" and smaller conveying liquids shall be heat traced, insulated, and covered with an aluminum insulation jacket cover. Pipes with continuous flow are exempt from this requirement.

w. Pipe bells shall be installed in upstream direction.

x. Air release valves shall be A.R.I. Model D-025. ARV vent piping to be Schedule 80 PVC with 316 stainless steel anchors and strut supports. Install a PVC ball valve below air release valve. Install union in vent piping adjacent to ARV.

y. PVC ball valves shall be Sch 80 true union type by GF, Hayward, Nibco, or Spears.

z. PVC male adapters are not allowed.

aa. Pressure gauge assemblies shall include the following items:

1) Stainless steel full port isolation ball valve.

2) Pressure diaphragm seal and plain end bibb sampling valve, both stainless steel.

3) 4" Pressure gauge, complying with ASME B40.1, Grade 1A, with 1% full scale accuracy, stainless case and stainless steel wetted parts, glycerin filled.

4) Gauges shall read in both ftH2O and PSI. Select range for normal working pressure to be mid-range.

5) The entire assembly shall be Type 316 stainless steel.

bb. Provide 1" Woodford Y1 non-freeze yard hydrant with 50ft heavy duty rubber hose, brass adjustable spray nozzle, and McMaster-Carr 53325K33 hose rack. Provide Watts 009 RPZ backflow preventer with brass pipe/fittings/valves, insulated and heated aluminum enclosure,

cc. Any potable water supply below the overflow elevation of the wet well shall be protected by an air gap.

dd. All lift stations must be evaluated for backup power requirements.

ee. Flow monitoring will be provided for all lift stations.

ff. SCADA monitoring and control unit will be required for all lift stations. Refer to CCSUD Electrical Design Criteria.

gg. Hydraulic structures must pass leakage testing prior to application of any coatings or linings. Fill with clean water to overflow level. Allow minimum 24-hour saturation period. Test duration is 1-hour. No allowable leakage. Test each basin or chamber separately. Any areas of visible moisture shall be repaired and retested.

hh. All testing shall be performed by the contractor and witnessed by CCSUD.

ii. Contractor shall perform operational demonstration testing (see attached procedure). Contractor shall startup, test, and verify all equipment is operational prior to scheduling GBRA to witness demonstration testing. Operator training shall be conducted on a separate day after demonstration testing. Contractor shall coordinate schedule with CCSUD at least two (2) weeks in advance.

jj. The contractor shall maintain service to existing wastewater systems at all times during construction. Any work involving power outages, bypass pumping, pump and haul, or any other interruption of flow must be performed between 8:00am and 5:00pm excluding weekends and holidays. All necessary temporary power, bypass pumping, pump and haul, temporary plugs, etc., shall be furnished and performed by the contractor. Coordinate and schedule any such activities with CCSUD at least two (2) weeks in advance.

kk. Explosives and blasting are not allowed.

15. Exceptions

Exceptions to these design criteria must be requested in writing. Written approval from CCSUD or a designee must be obtained before any exceptions will be allowed.

PART 3 CONSTRUCTION INSPECTION, ACCEPTANCE AND WARRANTY

3.1 CONSTRUCTION INSPECTION PROCEDURE

To have a CCSUD inspector assigned to a project, the following items must be submitted to the CCSUD. The appropriate contact person will be able to answer any questions regarding the following information:

A. Two (2) sets of signed plans are required. Also required are two (2) copies of signed contracts (lump sum contracts should include water and wastewater quantities on a developer's or consulting engineer's letterhead), two (2) sets of cut sheets with one (1) copy of field notes and two (2) copies of any permits listed on the front of the plans.
B. One (1) copy of the bid tabulation (if the project is bid out) will be required with the above listed items for all service extensions submitted for construction. All of these required items must be submitted at the same time. For reviews occurring during the construction phase, two (2) copies of the revised plans are required.
C. To set up a Pre-Construction Meeting, contact the CCSUD.
D. One (1) copy of the approved plans and contracts must be submitted to the CCSUD at least three (3) working days before the Pre-Construction Meeting.
E. The contractor shall call the One Call System for information on existing buried utilities.

3.2 CCSUD ACCEPTANCE

To obtain final CCSUD acceptance of a project, one (1) paper and digital copy ofRecord Drawings showing all field changes, along with the Engineer of Record must submit the CCSUD provided Closeout Submittal Form. Refer to CAD Deliverables in the Appendix for acceptable drawing formats. Also, a signed and sealed engineer's cost estimate for water and sewer improvements. The estimate needs to include line items for the following assets: sewer mains (length and size), sewer force mains (length and size), sewer services (number and size), sewer manholes (number), and sewer structures (number). Any outstanding fees, based on final cost figures, must be paid prior to final acceptance.

If landscaping and vegetation items are outstanding, a conditional acceptance letter may be issued. This allows for the release of letter of creditrequirement for the majority of the wastewater related work thathas been satisfactorily completed. When all work is completed and all necessary information is provided, a final acceptance letter will be issued.

If the project includes a lift station, the lift station will be considered separatelyfor operation and maintenance acceptance. (Refer to Section 3.3)

3.3 CONSTRUCTION WARRANTY

The correction of any damages or adjustments required to the facilities resulting from the final development of a project will remain the responsibility of the owner and/or developer. A two-year warranty on all sewer facilities shall begin upon the date of the acceptance letter.

END OF SECTION

SECTION 03600

WASTEWATER TREATMENT PLANT (WWTP)

PART 1 - GENERAL

1.1 SCOPE

A. This specification pertains to the design, fabrication, installation, and commissioning of a modular, prefabricated, coated-steel, field-erected decentralized modular wastewater treatment plant including all necessary tankage and equipment capable of conveying and treating domestic wastewater by means of the membrane bioreactor (MBR) activated sludge process operating in the Modified Ludzack-Ettinger mode. The Modular MBR System is a fully integrated system with all onboard and external tankage, pumps, blowers, controls, and accessories consisting of the following systems in general:

1. Influent Lift Station
2. Headworks
3. Flow Equalization System
4. MBR Process System including:
    a) Process Tank Assemblies with Interconnecting Piping and Valves
    b) Internally fed Rotary Drum Screen (2-mm, perforated plate)
    c) Membrane Modules and Appurtenant Hardware
    d) Process and MBR Scour Blowers and Controls
    e) Feed Forward Pumps and Controls
    f) RAS/Rescreen/WAS Pumps and Controls
    g) Permeate Pumps and Controls
    h) Process Chemical Dosing Systems
        1) Alkalinity Adjustment
        2) Chemical Oxidant/Coagulant
        3) Supplemental Carbon Feed
        4) Chlorine Disinfection [if required]
    i) UV Disinfection Equipment and Controls
    j) Clean in Place System
    k) Fully Integrated, PLC-based system controls and process instrumentation
    l) Factory-certified technician start-up, training, and testing
5. Sludge Holding System
6. Post Aeration System
7. Non-Potable Water System

8. Equipment Building
9. Spare Parts

B. Section Excludes:
1. Site civil and structural support systems
2. Fencing
3. Landscaping
4. Odor control
5. Potable water supply
6. Effluent pump stations

C. Modular MBR System Supplier shall furnish all tankage, equipment, controls, and appurtenances to complete and make ready for operation a modular, MBR-based wastewater treatment system as described herein and as shown on the Drawings. The supplier is solely responsible for the design, fabrication, assembly, delivery and startup of the system in accordance with the design criteria established in this specification.

1.2 RELATED WORK

The following sections define the work to accomplish interfaces to ensure the successful integration of the Modular MBR System into the balance of the project.

A. Section 01100 – Site Preparation
B. Section 01140 – Dewatering
C. Section 01230 – Excavation and Backfill
D. Section 01500 – Concrete for Structures
E. Section 02400 – Valves and Appurtenances
F. Section 03100 – Sanitary Sewer Main
G. Section 03200 – Sanitary Sewer Manholes
H. Section 03500 – Wastewater Design Criteria
I. Section 09900 - Painting
J. TxDOT Item 00550 – Chain Link Fence
K. Treatment Plant Equipment as specified in Division 11

1.3 REFERENCES:

A. Applicable Standards:
1. American Iron and Steel Institute (AISI).
a) AISI 4130 – Heat Treated Alloy Steel
b) AISI 4140 – Heated Treated Hexagon Steel
2. AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
a) ASME B1.20.1 (2018) Pipe Threads, General Purpose (Inch)

b) ASME B1.20.2M (2006; R 2011) Pipe Threads, 60 Deg. General Purpose (Metric)

1) ASME B16.1 (2020) Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250

2) ASME B16.3 (2016) Malleable Iron Threaded Fittings, Classes 150 and 300

3) ASME B16.4 (2016) Standard for Gray Iron Threaded Fittings; Classes 125 and 250

4) ASME B16.5 (2017) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard

3. American Society for Testing and Materials (ASTM):
   a) A29/A29M – Steel Bars, Carbon and Alloy, Hot-Wrought and Cold-Finished.
   b) A36 – Structural Steel Specifications.
   c) A48 – Gray Iron Castings.
   d) A53, Grade B – Pipe Specifications
   e) A325 – High Strength Fastener Specifications
   f) A370 – Mechanical Testing of Steel Products.
   g) A536 – Cast Iron Specifications
   h) 303 – Stainless Steel Material Specifications
   i) 304 – Stainless Steel Material Specifications
   j) 316 – Stainless Steel Material Specifications
4. American Gear Manufacturers Association (AGMA).
5. American Welding Society (AWS).
   a) AWS D1.1/D1.1M (2020) Structural Welding Code - Steel
   b) Welding in Building Construction Specifications.
6. American Society of Mechanical Engineers (ASME).
   a) ASME B1.20.1 (2013; R 2018) Pipe Threads, General Purpose (Inch)
   b) ASME B1.20.2M (2006; R 2011) Pipe Threads, 60 Deg. General Purpose (Metric)
   c) ASME B16.1 (2020) Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250
   d) ASME B16.3 (2016) Malleable Iron Threaded Fittings, Classes 150 and 300
   e) ASME B16.4 (2016) Standard for Gray Iron Threaded Fittings; Classes 125 and 250
   f) ASME B16.5 (2017) Pipe Flanges and Flanged Fittings
   g) NPS 1/2 Through NPS 24 Metric/Inch Standard Pressure Vessel Specifications.
7. American Water Works Association (AWWA).

a) AWWA C110/A21.10 (2012) - Ductile-Iron and Gray-Iron Fittings for Water

b) AWWA C111/A21.11 (2017) - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

c) AWWA C115/A21.15 (2020) - Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges

d) AWWA C151/A21.51 (2017) - Ductile-Iron Pipe, Centrifugally Cast

e) AWWA C200 (2012) - Steel Water Pipe - 6 In. (150 mm) and Larger

f) AWWA C206 (2017) - Field Welding of Steel Water Pipe

g) AWWA C207 (2018) - Standard for Steel Pipe Flanges for Waterworks Service, Sizes 4 in. through 144 in. (100 mm through 3600 mm)

h) AWWA C504 (2015) - Standard for Rubber-Seated Butterfly Valves

i) AWWA C508 (2014) - Standard for Swing-Check Valves for Waterworks, 2-inch through 24-inch

j) AWWA C540 (2002) - Power Actuating Devices for Valves and Sluice Gates.

k) AWWA C900 (2016) - Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 1,500 mm)

l) AWWA C550 (2017) - Protective Epoxy Interior Coatings for Valves and Hydrants.

8. Anti-Friction Bearing Manufacturers Association (AFBMA).
   a) Bearing Life Specifications.
9. Federal Communications Commission (FCC).
10. Institute of Electrical and Electronic Engineers (IEEE).
11. The Instrumentation, Systems and Automation Society (ISA)
12. ISO Standard 9001
13. Insulated Cable Engineers Association (ICEA)
14. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS)
    a) MSS SP-58 (2018) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation
    b) MSS SP-70 (2011) Gray Iron Gate Valves, Flanged and Threaded Ends
    c) MSS SP-78 (2011) Cast Iron Plug Valves, Flanged and Threaded Ends
    d) MSS SP-80 (2019) Bronze Gate, Globe, Angle and Check Valves
15. National Electrical Manufacturers Association (NEMA):
    a) NEMA ICS 1 (2000; R 2015) - Standard for Industrial Control and Systems: General Requirements
    b) NEMA ICS6 - Enclosures for Industrial Controls and Systems.
    c) NEMA MG 1 (2018) - Motors and Generators
    d) NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

16. National Fire Protection Association (NFPA):
    a) NFPA 70 - National Electrical Code.
    b) NFPA 820 - Standard for Fire Protection in Wastewater Treatment and Collection Facilities
17. Pipe Fabrication Institute (PFI)
18. Standards of the Hydraulic Institute.
19. Underwriters Laboratory (UL):
    a) 508 – Electric Industrial Control Equipment.

1.4 QUALITY CONTROL

A. Modular MBR System Manufacturer (Integrator): Company in continuous operation at the same fabrication facility for more than 10 years specializing in manufacturing products specified in this Section with five years' documented treatment system fabrication experience.

B. Modular MBR System Designer: Professional engineer experienced in design of MBR wastewater treatment systems with not less than 10 operating MBR system references.

C. Modular MBR Control System Integrator: Professional electrical or controls engineer experienced in design of MBR wastewater treatment systems with not less than 10 operating MBR system references.

D. Installer: Company specializing in erecting and placing in operation MBR wastewater treatment systems with not less than five years' documented, continuous experience and not less than 10 operating MBR systems with references.

1.5 COORDINATION REQUIREMENTS

This section identifies the requirements of the various parties for the furnishing, installing, testing, training, startup, and warranty support for the Modular MBR System.

A. Modular MBR System Supplier shall provide engineering, design, labor, tools, rigging, materials, and incidentals required for the installation and commissioning of the Modular MBR System.

B. Contractor shall prepare the plant site to receive the Modular MBR System; including, but not limited to, site civil preparation, yard piping and conduit runs to the System points of connection, foundations, paving, grading, site access control and security during construction and all temporary utilities including water, power, and sanitary facilities.

C. Engineer is responsible for coordinating the Work of this section with the work and services of others involved in the project. All questions which may arise as to the interpretation of any or all Plans and Specifications and all questions as to the acceptable fulfillment of the Contract on the part of the Contractor and Suppliers shall be resolved by the Engineer.

1.6 SUBMITTALS

A. Process and Instrumentation Diagrams (P&IDs) showing all equipment and instrumentation included with the Modular MBR System.

B. The output of a biological process simulation (BioWin®) model supporting the stated treatment capacity of the Modular MBR System.

C. System installation drawings, detailing system dimensions, materials, weights, locations of lifting lugs/points, and anchor bolt locations.

D. System mechanical layout drawings, detailing the number of membrane units, air and permeate piping distribution, piping supports, instrumentation and valves, and all other components comprising the Modular MBR System. Drawings shall include plan, elevation, and sectional views sufficient for installation, configuration, and operation of the Modular MBR System.

E. Cut sheets for all components clearly identifying manufacturer, models, ranges, materials of construction, and installation details.

F. Installation and Operations Manual (IOM)

1. One hard copy of the IOM shall be provided along with an electronic copy in PDF format. Include all manuals, drawings, and related documentation necessary for the assembly, installation, and operation of the Modular MBR System.

2. Mechanical and Process Control System Commissioning procedures.

G. Modular MBR System Supplier Qualifications

1. Modular MBR System Supplier must demonstrate a minimum of five (5) years active experience in the design and manufacture of membrane bioreactor packaged treatment systems for the treatment of municipal wastewater, and upon request, furnish supporting evidence.

2. The Membrane Module Supplier must demonstrate a minimum two (2) year history of successful MBR installations in North America acceptable to the Engineer and the Owner.

H. Warranties and Guarantees

1. Warranties and guarantees shall commence at Substantial Completion of the system or 6 months from delivery of the packaged plant to site, whichever occurs sooner.

2. Mechanical Warranty: All mechanical equipment shall be guaranteed for one (1) year, parts, and workmanship.

3. Membrane Warranty: The Modular MBR System Supplier warrants that the membrane modules to be used for treatment of wastewater will be suitable to achieve the effluent water quality in terms of flow and TSS as indicated herein for a period of not less than 60 months after date of Substantial Completion. The first 12 months of the Modular MBR System Supplier Membrane Module Warranty Period shall be a full replacement warranty, with the balance of the Warranty Period covered under a prorated warranty. Warranty shall include cost of membrane repair or replacement, at the Modular MBR System Supplier's discretion. Any membrane modules replaced under warranty shall assume the remaining warranty of the membrane modules.

a) Limitation of Membrane Module Warranty: The Owner recognizes that the occurrence of any of the following may void the membrane warranty.

1) Physical damage or faulty installation of the membrane modules by others.

2) Unauthorized alteration by others of components not manufactured by the Modular MBR System Supplier.

3) Catastrophic exposure to chemicals not normally associated with wastewater treatment because of accidents, vandalism, or other acts that are totally outside the bounds of routine and normal wastewater treatment plant operations.

4) Use of water treatment chemicals, chemical cleaning solutions, or cleaning procedures other than chemicals, solutions and procedures approved by the Modular MBR System Supplier, other than those prescribed in the Procurement Documents.

5) Exposure of the membranes to wastewater treatment or treatment chemicals at concentrations, levels, or contact times unacceptable to the Modular MBR System Supplier. The Modular MBR System Supplier is responsible to provide the Owner a listing of the known wastewater treatment and cleaning chemicals and concentrations and time of exposure that could result in a loss of membrane integrity or cause irreversible fouling. Operation or cleaning of the membrane outside the stated limits shall void the remaining portion of the membrane warranty. Such conditions include:

   i) Inappropriate operation of the biological system that results in exposure of the membrane modules to mixed liquor suspended solids concentrations more than design values, for more than 24 hours greater than three times per year or a cumulative total of 72 hours.

   ii) Catastrophic exposure to chemicals not normally associated with water or wastewater treatment because of accidents, vandalism, or other acts outside the bounds of routine and normal treatment plant operation.

   iii) Exposure to fats, oils, and grease at concentrations greater than 500 mg/l.

   iv) Use of chemicals or cleaning procedures other than those recommended and approved by the Modular MBR System Supplier.

   v) Exposure of the membranes to treatment or cleaning chemicals at concentrations above levels or contact time or temperatures acceptable to the MBR Supplier.

6) Improper operation or maintenance of equipment, as defined by the O&M Manual.

7) If the Owner fails to perform its obligations under the warranty or any other agreement between the Owner and the Modular MBR System Supplier

8) Owner fails to pay any charges otherwise due the Modular MBR System Supplier.

9) Changes in the Modular MBR System Supplier's established operational and maintenance guidelines cannot be applied retroactively to invalidate the membrane module warranty.

4. Process Guarantee: The Plant shall include a performance (or process) warranty for a period of one (1) year following successful completion of commissioning, that guarantees that the effluent from the wastewater treatment plant will be equal to or less than the effluent limits specified herein when the plant is operated properly by

a trained, State licensed or certified operator holding a license or certification appropriate to the rate.

1.7 DEFINITIONS

A. For the purposes of this specification terms have meanings indicated below which are applicable to both the singular and plural thereof:

1. AADF: Average annual daily flow is the net daily flow lasting approximately 7 – 9 months.
2. Average Flux Rate (GFD): The permeate produced (in gallons per day) divided by the outside surface area of the membrane (in square feet), calculated over a period of 60 minutes or more.
3. Clean-in-Place (CIP): Any instance in which a Membrane Train is taken offline and subjected to cleaning chemicals for a period of approximately 30 minutes. The CIP procedure may be manual, automated, or semi-automated and uses one or more cleaning chemicals to reverse the effects of Membrane Fouling. This process may also be termed Recovery Clean.
4. Design Flow: The word “Design Flow” is interchangeable with the word “Net Flow”.
5. Instantaneous Flux Rate (GFD): The permeate produced (in gallons per day) divided by the outside surface area of the membrane (in square feet), calculated based on flow rate at a given instant in time.
6. Instantaneous Flow Rate: Equals the Permeate flow rate produced during the service cycle in gallons per day. Service cycle is defined as the period of continuous permeation between the membrane relaxation and backpulse where the Manufacturer’s equipment uses relaxation and/or backpulse as a permeability maintenance method.
7. Maintenance Clean: Any instance in which a Membrane Train is taken offline and subjected to cleaning chemicals for a period of approximately 30 minutes to 2 hours with the goal of removing foulants from the membrane surface to lower the TMP.
8. MBR system (OR, membrane bioreactor system): All equipment, materials, and appurtenances required for a complete functioning system, meeting all performance requirements as specified herein.
9. Membrane Module (Cassette): The smallest assembled unit of the membrane system that is designed to be removed from a membrane system and replaced as a complete unit.
10. Membrane Train: A stand-alone set of Membrane Modules operated as one unit.
11. MLSS: Mixed liquor suspended solids.
12. MMDF: Maximum month daily flow is the net daily flow lasting approximately 3 – 5 months.
13. PPF: Peak period net daily flow (occurs for a maximum of 15 consecutive days, twice per year typically during Holidays).
14. PHF: Peak hourly net flow lasting approximately 4 -10 hours.
15. Performance Test: A performance run which demonstrates the system meets the performance requirements specified.

16. Permeate: Water produced by the membrane filtration process
17. RAS: Return activated sludge.
18. WAS: Waste activated sludge FOG: Fats, oils, and greases.
19. Beneficial Use: The Modular MBR System is functioning and treating wastewater to the benefit of the Owner.
20. Contractor: The company responsible for preparing the plant site to receive the Modular MBR System, including, but not limited to, site preparation, foundations, paving, grading, off system equipment, yard piping and conduit runs to the System points of connection/interfaces, site access control and security and temporary utilities including water and power.
21. Online Monitoring: Web-based online monitoring tool for monitoring and optimizing membrane performance through data analysis.
22. Engineer: The company responsible for integrating the Modular MBR System into the balance of the plant and for verifying that the system complies with all governing codes and Agency-issued discharge or water reuse permit requirements.
23. Equipment Platform: A dedicated, integral skid, built into the System, where equipment, piping, and controls are attached. the Modular MBR System includes an Upper Platform and a Lower Platform.
24. Onboard/Offboard: All components physically mounted to the Process Tank Assembly whether at the factory or in the field, are “onboard”. All other components, located in the field, are “offboard.”
25. Clean-In-Place (CIP): A CIP is generally synonymous with Maintenance Cleaning but can also refer to a Recovery Cleaning. A Maintenance Cleaning is performed in-situ and in mixed liquor or activated sludge. The procedure is conducted by charging cleaning chemicals to membranes in the reverse direction of permeate flow with a soak time lasting more than 2hr – 6hr. A Recovery Cleaning is performed in-situ and in water or dilute chemical. The procedure is conducted by charging cleaning chemicals to membranes in either direction with a typical soak time of 8hrs.
26. Modular MBR System: a pre-assembled, transportable, integrated biological treatment process that uses submerged membranes for the purposes of solids, liquid separation. An MBR System is an integrated assembly of treatment equipment, tankage, and controls capable of providing full biological treatment of wastewater.
27. MBR System Supplier: the company responsible for providing all system design, integration, manufacturing, delivery, and installation of the Modular MBR System and for providing warranty support.
28. Zone: area within a process that is designed, programmed, and operated to perform a specific function.
29. Membrane Unit (MU): A Membrane Unit is an assembly generally consisting of a Membrane Module and a Diffuser Module.
30. Owner: The owner shall act as the buyer, typically through a General Contractor as Agent, who will also act as the end-user responsible for the operations of the facility.
31. Production Capacity: The net permeate flow rate over a given period of continuous operation accounting for CIP procedures and relaxation.

32. MLSS: Mixed liquor suspended solids concentration generally reported in units of in mg/l.
33. Permeability: Equals the instantaneous flux rate divided by the transmembrane pressure (TMP). The units of permeability are gfd/psi.
34. Relaxation: A temporary suspension of membrane filtration with continued air scouring for the purpose maintaining treatment capacity or reducing CIP requirements.
35. Transmembrane Pressure (TMP): The effective pressure differential across the membrane during normal operation.
36. HRT/SRT. Hydraulic Retention Time (HRT) is the total time, the wastewater is in contact with the activated sludge in all the various process zones including the membrane zones before it is pumped out. Solids Retention Time (SRT) is the total time, the incoming solids and solids generated in the process basins (referred as activated sludge) stay in the various process zones including the membrane zones before wasting occurs.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MODULAR MBR SYSTEM SUPPLIERS

BluBoxMBR, LLC

4001 North Valley Drive
Longmont, CO 80504
(720) 221-4366

2.2 INFLUENT LIFT STATION

A. The Modular MBR System Supplier shall furnish all tankage, equipment, controls, and appurtenances to complete and make ready for operation an onsite Influent Lift Station as described herein and as shown on the Drawings. The Supplier is solely responsible for the design, fabrication, assembly, delivery, field-erection, and startup of the system in accordance with the design criteria established in this specification.

B. Influent Lift Station shall include a suitable wet well for the soil conditions and anchoring requirements, redundant pumps configured for duplex, triplex, or quadplex operations and sized in accordance with the Engineer's flow requirements as per the plans and specifications.

C. All lift stations shall conform to CCSUD's Wastewater Design Criteria, Electrical Design Criteria and standard specifications and details.

D. All pumping systems shall include the necessary access and hardware for safe and secure access and removal of equipment by utility personnel.

E. All equipment and controls supplied shall meet the operating conditions required for pumping raw sewage materials conveyed from force and gravity conveyance systems.

F. All equipment and controls supplied shall be fully integrated with the Modular MBR Process Control Systems for proper operation and monitoring.

G. Local disconnects for all mechanical equipment shall be provided for proper servicing.

2.3 HEADWORKS

A. The Modular MBR System Supplier shall furnish all structural access platforms, equipment, controls, and appurtenances to complete and make ready for operation an onsite Headworks as described herein and as shown on the Drawings. The Supplier is solely responsible for the design, fabrication, assembly, delivery, field-erection, and startup of the system in accordance with the design criteria established in this specification.

B. The Headworks equipment will be required to meet the membrane warranty of the supplied membrane technology and shall have the following performance parameters:

1. Headworks shall be sized to accommodate the peak flows from the Influent Lift Station with the appropriate redundancy requirements.
2. Fine Screen shall have a maximum perforation opening of 2 mm or as required to meet membrane warranty of the membrane technology supplied.
3. 90% Screen Capture Efficiencies.
4. Maintain Coarse Suspended Solids (CSS) in the membrane basins at a maximum of 200 mg/L or less as recommended by the membrane technology.
5. Maintain no higher than the maximum level of Grit, as defined as recommended by the membrane technology.
6. All screens shall include a screenings washer and compactor.
7. The Headworks shall include all necessary platforms, stairways, walkways, and handrails for proper access and operation in accordance with the plans and specifications.

C. All headworks screenings conveyance systems shall be supplied with the ability to install odor control measures if required.

D. Local disconnects for all mechanical equipment shall be provided for proper servicing.

2.4 FLOW EQUALIZATION (EQ) SYSTEM

A. The Modular MBR System Supplier shall provide a minimum of one (1) field-erected Flow EQ tank supplied as shown on the plans.

B. Minimum Flow EQ volume shall be determined based on Engineer's design.

C. The Flow EQ System shall include the required aeration system, influent pumping systems, level transmitter, high level switch, and carbon vent.

D. The Flow EQ Tank shall include the minimum flanges/connections for all required liquid and air connections as well as the required manway or access hatch.

E. The Flow EQ Tank shall be equipped with an air distribution system to provide 30 scfm per 1,000 cf of basin volume. The coarse bubble diffusers shall be located as shown on the drawings.

F. Local disconnects for all mechanical equipment shall be provided for proper servicing.

2.5 MBR PROCESS ASSEMBLIES

A. The Modular MBR System Supplier shall furnish a complete MBR Process with prefabricated assemblies including all required tankage, equipment, controls, and

appurtenances to complete and make ready for operation an MBR Process as described herein and as shown on the Drawings. The Supplier is solely responsible for the design, fabrication, assembly, delivery, field erection, and startup of the system in accordance with the design criteria established in this specification.

B. MBR Process Design and Performance Criteria

1. Hydraulic Capacity

MBR systems are typically designed with screened equalization tankage prior to the MBR System. The Modular MBR System shall be designed to hydraulically treat flows noted below.

Table 2.5.1: Hydraulic Design Criteria

Parameter	Value	Unit	Net Flux	Value	Duration[1]	Units
Design Flow		MGD		gfd		days/yr
Peak Day Flow		MGD		gfd		days/yr
Peak Hour Flow		MGD		gfd		hrs/day

[1]Duration figures used to project CIP requirements but do not limit capacity. Durations may not be consecutive.

2. Influent Loading & Effluent Targets

The MBR System shall be capable of treating raw wastewater at listed flows to the specified effluent criteria noted below.

Table 2.5.2: Process Design Criteria

Parameter	Influent Conc.		Influent Loading		Effluent Targets	
BOD_5		mg/l		lbs/day		mg/l
TSS		mg/l		lbs/day		mg/l
TKN		mg/l		lbs/day		mg/l
NH_3-N		mg/l		lbs/day		mg/l
TP		mg/l		lbs/day		mg/l
TN		mg/l		lbs/day		mg/l
Turbidity		NTU		NTU		NTU
Alkalinity		mg/l		lbs/day		mg/l

3. Process design and operating assumptions explicitly include the following:

a) Higher levels of any parameter impact treatment capacity and maintenance requirements.

b) Influent FOG shall not exceed 50 mg/l.

c) No substances shall be placed in the system in quantities which are not biodegradable or toxic to the biological system.

4. Modular MBR System Dimensions & Weights
    a) Weights:
        1) The shipping weight of the Modular MBR System should be assumed to be 50,000 lb.
        2) The operating weight is assumed to be 250,000 lb full of water.
    b) Dimensions:
        1) The bottom footprint dimensions of the System shall be no more than 45'-0" x 8'-6"
        2) The maximum shipping height of the System shall be no more than 12'
        3) The installed tallest field-erected point shall be the CIP vent; approximately 17'-8". The tallest point for the Fine Screen is 17'-1".
        4) The hook height for Membrane Module removal shall be approximately 9'-10".

C. MBR Process General Arrangement

1. The MBR Process shall be sized and configured for the design influent and effluent criteria in accordance with local and state regulations. The MBR Process is comprised of a minimum of one (1) Process Tank Assembly, Supplemental Tank Assemblies (as needed), a fully integrated Electrical & Controls System that provided operator interface with the entire Modular MBR System, and up to eleven discrete Subsystems or process Zones.
2. Each MBR Process Tank Assembly includes one Tank that shall be divided into 4 separate process Zones. Equipment platforms, an upper and lower, are structurally integrated into one end of the Tank Assembly. The Tank and Platforms are structurally supported by common beams for the purposes of handling, transporting, and mounting.
3. Each MBR Supplemental Tank Assembly includes one Tank that shall be divided into 3 separate process Zones. Equipment platforms, an upper and lower, are structurally integrated into one end of the Tank Assembly. The Tank and Platforms are structurally supported by common beams for the purposes of handling, transporting, and mounting.
4. The MBR Process shall be configured with one Anoxic Zone, one Pre-Aeration Zone, and two Membrane (MBR) Zones. Each zone shall be separated by a welded baffle that shall be hydraulically rated. Every zone can be fully drained if needed. A field-mounted fine screen (FS) shall be located on top of the Anoxic Zone.
5. Influent wastewater shall be pumped into the FS and flows through a drum screen into the Anoxic Zone where it shall be mixed into the biological process. Mixed liquor shall be pumped from the Anoxic Zone into the Pre-Aeration Zone where it then flows by gravity into one of 2 MBR Zones (operated in parallel) and back to a varying level Anoxic Zone.
6. Submerged membrane modules filter treated water out of the process. A small side stream of mixed liquor shall be intermittently pumped to the FS for removal of accumulated hair and fiber.
7. Redundancy for every major piece of process equipment including pumps and blowers shall be provided.

8. Each piece of equipment shall be provided with shut off valves or mechanisms so that it may be isolated or by-passed, while the Modular MBR System continues to operate.

D. MBR Process Structural

1. Tank Materials

    a) Plates, Angles, and Channel Shapes:

        1) Carbon steel plates, angles and shapes shall conform to the requirements of ASTM A-36 with a minimum yield strength of 36,000 psi.

        2) Floor and wall plates shall be ¼" thickness.

        3) Aluminum plates, angles and shapes shall be 6061 alloy with a T6 temper.

    b) Carbon Steel Pipe: Carbon steel pipe shall conform to the requirements of ASTM A-53, type S, Grade B and ASME B16.10, schedule 40.

    c) Stainless Steel Pipe: Stainless steel pipe shall conform to the requirements of ASTM A-312, TP304 and ASME B36.19, schedule 10 or 40, as specified in tank drawing nozzle schedule.

    d) Unistrut: Unistrut structural members shall be P1000, 1 5/8", stainless steel.

2. Tank Fabrication

    a) Tank welding shall conform to the requirement of ANSI/AWWA D-100-05: Welded Carbon Steel Tanks for Water Storage.

    b) Tank welding shall conform to the requirement of ANSI/AWWA D-100-05: Welded Stainless-Steel Tanks for Water Storage.

    c) All welds shall be continuous seal welds.

    d) Tank construction shall conform to applicable sections of AISC, 13th Edition of the Steel Construction Manual.

3. Finishes, Carbon Steel Tanks

    a) All internal and external carbon steel surfaces shall be painted.

    b) All stainless-steel surfaces and piping shall be painted.

4. Internal Paint:

    a) Preparation: Prepare internal tank surfaces to a near white metal blast of 3 mil profile per SSPC-SP10, free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter.

    b) Application: Apply interior paint in one coat to a 10-14 mils DFT thickness. Deposit by stripe coat on inside and outside corners followed by an immediate full coat application. Material should be brushed into cavities behind pipe penetration flanges as part of the stripe coat process. Observe all coating manufacture's requirements for application (pot life and recoat times).

    c) Paint shall be Carboline Phenoline Liner 341.

5. External Paint

    a) Preparation: Prepare internal tank surfaces and equipment platforms to a near white metal blast of 3 mil profile per SSPC-SP10, free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign

matter.

b) Application: Apply exterior epoxy primer paint at 4-6 mils DFT in one coat. The underside of the tank shall be treated as the exposed sides. Apply top coat of polyurethane paint @ 2-3 mils thickness. Observe all coating manufacture's requirements for application (pot life and recoat times).

1) Primer Paint shall be Carboline Carboguard 893; Gray (0700).

2) Top coat shall be polyurethane Carboline Carbothane 134HS.

c) Finish Color (Top Coat).

1) "Brilliant Blue" RAL 5007 (Carboline Color Code 9109) shall be used on all vertically corrugated surfaces ONLY.

2) "Telegrey 4" RAL 7047 (Carboline Color Code 2792) on all non-corrugated and horizontally corrugated surfaces.

B. MBR Process Subsystems

1. Internally Fed Rotary Drum Screen

a) The Modular MBR System is designed to receive primary-screened wastewater (2-mm perforated plate, typical). The System shall be equipped with a fine screen proven in polymeric membrane bioreactor service conforming to the design criteria specified below. Each Internally Fed Rotating Drum Screen unit shall consist of a fully enclosed Perforated Plate Rotating Drum Screen basket, internal flight solids conveyance, integral high-flow bypass, high-pressure spray bar, local control panel interlocked with main plant PLC, backwash water booster pump.

b) Fully automatic, internally fed, perforated plate media, cylindrical drum screen designed to receive pumped flow from primary screened municipal wastewater.

c) Cylindrical drum screen constructed of perforated plate media from type 304L stainless steel with perforations around the entire basket.

d) Conveying/dewatering flights shall form an internal spiral along the entire length of the drum screen cylinder from type 304L stainless steel.

e) Cleaning brush and spray bar on the outside of the screen drum cylinder to prevent small solids from passing through the screen.

f) Overflow pipe with sensor to detect overflow condition.

g) The unit shall be fully enclosed and incorporate a hinged hood for complete access to the perforated drum, spray bar and brush; all from type 304L stainless steel.

h) Provide one (1) NEMA 7 safety microswitch mounted to discharge access door.

i) All fabricated parts of the screen will be 304 stainless steel

j) System Configuration and Design Criteria

Number of units	
Average flow, per screen, [gpm]	

Hydraulic capacity, per screen, [gpm]	
Basket openings, [mm]	2.0
Nominal basket diameter, inches	
Wash system flow rate, gpm (maximum)	20
Wash system pressure, psig (min)	70
Main control panel enclosure type	NEMA 4X Stainless Steel
Hazardous area classification for the screen	Non-Hazardous

k) Manufacturer:

l) SAVI (FKA Enviro-Care): Flo-RotoDrum Internally Fed Rotating Drum Screen, Model RTV, or equivalent.

2. Membrane Clean In Place (CIP)

a) Provide a fully functional, fully automated membrane clean-in-place (CIP)system to maintain production capacity and meet performance requirements specified herein. The allowable frequency of listed cleaning methods shall be as follows:

1) Backpulse or Backwash shall not exceed 8 per hour.

2) Maintenance Clean or CIP frequency shall not exceed 1 in 2 weeks.

3) Recovery Clean frequency shall not exceed 4/yr.

b) CIP System controls shall be integrated into the PLC and SCADA within the MBR system Panel.

c) System shall be fully automated and not require any operator intervention other than refilling clean-in-place chemical tanks.

d) CIP System shall include:

1) Mix tank(s).

2) Chemical injection pump(s).

3) Isolation valves.

4) Check valves.

5) Flow Meter(s).

6) Automated diversion valve(s).

e) Manufacturer: MBR System Supplier Selection

3. Pumps.

a) All on-board pumps irrespective of the service shall be of like type, make and model.

b) Each pump shall be progressing cavity.

c) Unless otherwise noted as off-board, pumps shall be factory installed, pre-plumbed and pre-wired.

d) Each pump shall have isolation valves and gauges on the inlet and outlet.

e) Pump controls will be integrated into the PLC and SCADA within the MBR system Panel.

f) Motor controls and HOA will be integrated into the MBR System Panel.

g) Each pump shall have a remote disconnect.

h) Pump motor shall be inverter-duty rated and operated via Variable Frequency Drives.

i) Major pump components shall be cast iron for casings and NBR

j) Manufacturer: Seepex, or equivalent.

4. WAS System

a) Provide a fully functional Sludge Wasting System.

b) WAS controls shall be integrated into the PLC and SCADA within the MBR system Panel.

c) System shall be fully automated and not require any operator intervention.

d) Sludge shall be removed from membrane tanks.

e) Offboard solids handling will be by others.

f) System shall include:

1) WAS Pump

2) Automated Diversion valves(s)

3) Isolation valves.

4) Gauges

5) Check valves.

g) Manufacturer: MBR System Supplier Selection

5. Re-screen System

a) Provide a fully functional Re-screen System.

b) Re-screen System controls shall be integrated into the PLC and SCADA within the MBR system Panel.

c) Re-screen at minimum 15% of the total system tank volume daily.

d) Re-screen shall be taken from each membrane tank.

e) System shall be fully automated and not require any operator intervention.

f) System shall include:

1) Re-screen Pump

2) Automated Diversion valves(s)

3) Isolation valves.

4) Gauges

5) Check valves.

g) Manufacturer: MBR System Supplier Selection

6. Blowers.
    a) Blowers provide air scour to the membranes and oxygen into the biological process.
    b) Blower shall be either positive displacement or regenerative type.
    c) Unless otherwise noted as off-board, blowers shall be factory installed, pre-plumbed and pre-wired.
    d) Blower controls shall be integrated into the PLC and SCADA within the MBR system Panel.
    e) Blower motor shall be inverter-duty rated and operated via Variable Frequency Drives.
    f) Motor controls and HOA will be integrated into the MBR System Panel.
    g) Each blower shall have a remote disconnect.
    h) Blowers shall accommodate a minimum surge or 1.5 psig under normal operating conditions.
    i) Blowers shall be provided complete with inlet and exhaust silencers with filters, pressure relief valves, check valves, motors, pressure gauges, and mounting equipment. Fittings shall be stainless steel.
    j) Sound level shall be ≤77 dba @ 5'.
    k) Manufacturer: FPZ, Aerzen, or equivalent.
7. Analytics
    a) Analytics will provide system measurements used for operational control and adjustments.
    b) Unless otherwise noted as off-board, instruments shall be factory installed, pre-plumbed and pre-wired.
    c) Instruments will be integrated into the PLC and SCADA within the MBR system Panel.
    d) Transmembrane Pressure Measurement (TMP)
        1) Permeate Pressure transmitter shall be used for calculating the TMP of the membrane units.
        2) The TMP pressure transmitter shall produce a 4-20mA signal for PLC input.
        3) Manufacturer: Endress + Hauser, or equivalent.
    e) Flow Meter(s).
        1) The flow meter shall be used to measure the instantaneous flow of treated effluent.
        2) The flow meter shall produce a 4-20mA signal for PLC input.
        3) Manufacturer: Endress & Hauser, or equivalent.
    f) Turbidity Meter(s).

1) The turbidity meter shall be provided for membrane integrity and effluent quality monitoring.

2) Manufacturer: HACH, or equivalent.

g) Controller(s).

1) Multi-channel controller that operates multiple sensors.

2) Manufacturer: HACH, or equivalent.

h) Dissolved Oxygen (DO).

1) DO measurement shall be sampled continuously. This provides for automatic operational adjustments for DO control in the process zones.

2) Manufacturer: HACH, or equivalent

i) Level Transmitter.

1) Ultrasonic.

2) Manufacturer: Blue Ribbon or equivalent

j) Level Switch.

1) Mechanical.

2) Manufacturer: Conery or equivalent

k) Total Suspended Solids (TSS)

1) TSS measurement shall be sampled continuously in the MBR zone. This provides for operational adjustments to control the MLSS level in the MBR zone.

2) Manufacturer: HACH, or equivalent.

8. Process Chemical Dosing Systems

a) System Design

1) Process Chemical Dosing subsystem shall include two (2) identical peristaltic metering pumps designed to add adequate carbon and alkalinity for biological treatment, if needed, as well as to add coagulant for total phosphorus removal and chlorine for disinfection residual,if required.

2) Refer to chemical feed Process and Instrumentation Diagram in the project plans

b) System Components:

1) Mix tank(s).

2) Chemical injection pump(s).

i) Controlled by operator -selected feed rate in the integrated MBR control panel

ii) Capable of feeding up to 2.2-gph

3) Isolation valves.

4) Check valves.

5) Flow Meter(s).

6) Automated diversion valve(s).

9. Ultraviolet (UV) Disinfection System

a) Each Process Tank Assembly shall include an UV Disinfection System consisting of four inline UV units.

b) The four UV units operate in parallel with two (2) duty units and two (2) standby units for redundancy.

c) Each UV unit is rated for up to 40 gpm given a transmissivity of at least 50%.

d) Each unit includes a self-cleaning, stainless-steel wiper to prevent quartz fouling.

e) An alarm shall be generated when it is time for a lamp to be replaced. Isolation valves are installed for each unit.

f) An electrically actuated valve is installed downstream of the UV lamps to prevent gravity permeate flow during intermittent mode. An air relief valve is located at the piping highpoint.

10. Platforms and Walkways

a) Fine Screen Platform

1) Provide an aluminum walkway over the Anoxic Zone for access to the Fine Screen.

2) Structural Design Basis: Design platform structural members for worst case loading condition including all mechanical and piping loads as well as the loads noted below.

i) Uniform load of 100 lbf/sq. ft. or concentrated line load of 1000 lbf, or point load of 300-psf, whichever produces the greater stress.

ii) Limit maximum deflection to L/240 or 1/4 inch, whichever is less

iii) Platform walking surface shall include texturing to achieve a non-slip surface equivalent to a static coefficient of friction of not less than 0.6 when measured by ANSI /NSFI B101.3.

3) Provide aluminum handrails compliant with OSHA .1910.29 - Fall protection systems.

b) Upper Mechanical Platform

1) Provide an aluminum or painted steel platform over the Lower Mechanical Platform integral to the MBR Structure generally as indicated in the project plans.

2) Structural Design Basis: Design platform structural members for worst case loading condition including all mechanical and piping loads as well as the loads noted below.

i) Uniform load of 100 lbf/sq. ft. or concentrated line load of 1000 lbf, or point load of 300-psf, whichever produces the greater stress.

ii) Limit maximum deflection to L/240 or 1/4 inch, whichever is less.

iii) Platform walking surface shall include texturing to achieve a non-slip surface equivalent to a static coefficient of friction of not less than 0.6 when measured by ANSI /NSFI B101.3.

3) Provide aluminum handrails compliant with OSHA .1910.29 - Fall protection systems.

c) Lower Mechanical Platform

1) Provide an aluminum or painted steel platform under the Upper Mechanical Platform integral to the MBR Structure generally as indicated in the project plans.

2) Structural Design Basis: Design platform structural members for worst case loading condition including all mechanical and piping loads as well as the loads noted below.

i) Uniform load of 100 lbf/sq. ft. or concentrated line load of 1000 lbf, or point load of 300-psf, whichever produces the greater stress.

ii) Limit maximum deflection to L/240 or 1/4 inch, whichever is less.

iii) Platform walking surface shall include texturing to achieve a non-slip surface equivalent to a static coefficient of friction of not less than 0.6 when measured by ANSI /NSFI B101.3.

11. Stairs

a) Provide aluminum stairs for access to the Upper Mechanical Platform and the Fine Screen platforms that are compliant with OSHA .1926.1052 – Stairways.

12. Support Utilities (Automated CIP Optional)

a) Electrical

The Modular MBR System requires 480/3PH/60HZ power and 250 Amp minimum service (provided by others). Two electrical panels are located on the Bottom Platform. All electrical loads including convenience outlets, instruments, motors, automated valves are pre-wired. Only one field connection is required.

b) Plant Water

The minimum continuous demand is 16 gpm at 70 psig. There are three demands for plant water onboard the Modular MBR System, fine screen wash water, membrane Maintenance Cleaning, and module rinsing. The demands are defined further below.

Plant Water Demand

Type	Potential Demand	Min. Flow (gpm)	Design Flow (gpm)	Max. Flow (gpm)	Min./Max. Pressure	Notes
Wash Water	Continuous	16	16	16	70/80	6hr per day
Module CIP	Periodic	0			35/85	Does not require PW.

Module Rinse	Periodic	0			>35psig	Not routine maintenance.

13. Controls

a) General Requirements

1) Provide an integrated Modular MBR Control System in a freestanding Control Panel (CP)mounted on the Lower Platform.

2) Control Panel shall include the PLC, HMI, hand switches for valves, motor controls, VFD, starters.

3) Panel shall be factory installed and wired to all components onboard (mounted to the Process Tank Assembly).

4) Panel shall be UL508A listed.

5) Provide and install all electrical and controls conduits, wires, and appurtenances necessary to power all components of the MBR System.

6) General Contractor shall provide electrical power and conduit to the Panel and between the CP and any electrical items installed separately (offboard) from the Modular MBR System.

b) Motor/PLC Control Panel (CP-1)

1) Provide a NEMA 4 rated, steel enclosure, factory installed Control Panel floor-mounted to the Lower Platform. Wire CP to all other components of the Modular MBR System. All input and output (I/O) devices shall be wired to terminal blocks inside the CP.:

2) Uninterrupted Power Supply (UPS): 120VAC power for PLC components and the HMI.

3) Heater and thermostat for climate control.

4) Surge protective device for main power.

5) Control power transformer: 15KVA, 480VAC, 1 phase 60Hz primary, 120X240VAC secondary

6) 24 VDC power supply.

7) Allen Bradley CompactLogix PLC programmed to control equipment included with the Modular MBR System as described by the System Designer's approved P&IDs and Control Narrative. Additional, off-board, equipment can be controlled on a project specific basis.

8) 16 port ethernet switch.

9) 10" color touch screen operator interface.

10) VPN interface for remote access to PLC and HMI and data collection.

11) Web-based alarm dialer.

12) Pilot devices as required.

13) Intrinsic safety barriers as required.

14) SCADA System shall be an Allen Bradley Panelview Plus 7 with a 10.5" display that is factory mounted in the CP.

i) SCADA System shall include a graphical interface, trending capability, remote monitoring, remote alarming, and remote plant control.

ii) Remote capabilities shall include HMI monitoring and control, as well as the necessary telemetry to provide proper communication with CCSUD's existing SCADA platform as specified in CCSUD's Electrical Design Criteria.

15) Provide door mounted interface modules for manual control of each variable frequency drive (VFD).

16) Provide Hand-Off-Auto (HOA) switches for all full voltage starters.

17) VFDs and FVNR starters as required.

18) VFDs will include motor protector breakers and line reactors.

19) Full voltage starters will include motor protector breakers and starter contactors.

20) All motors include selector switches for manual motor operation.

21) All VFDs include panel mounted HIM modules for manual speed control and trouble shooting.

c) Local Disconnects

1) Provide local disconnects for every piece of rotating equipment on the Modular MBR System.

2) Disconnects shall be NEMA 4, Polycarbonate or Aluminum; UL-listed as manufactured by Altec.

d) Outlets & Lighting

1) Provide (2) 115-v outlets near the main pumping units powered by a transformer in MCP-1.

2) Plant lighting shall be provided in accordance with local utility requirements.

2.6 SLUDGE HOLDING SYSTEM

A. The Modular MBR System Supplier shall provide a minimum of one (1) field-erected Sludge Holding System supplied as shown on the plans.

B. Minimum Sludge Holding Tank operating volume shall be determined based on Engineer's loading criteria and the estimated sludge production. The Sludge Holding Tank shall provide a minimum of 15 days of sludge storage capacity.

C. The Sludge Holding System shall include the required aeration system, level transmitter, high level switch, and carbon vent.

D. The Sludge Holding Tank shall include the minimum flanges/connections for all required liquid and air connections as well as the required manway or access hatch

E. The Sludge Holding Tank shall include a 3" Cam-Lok fitting for sludge draw down by pump and haul operations.

F. The Post Aeration Tank shall be equipped with an air distribution system to provide 30 scfm per 1,000 cf of basin volume. The coarse bubble diffusers shall be located as shown on the drawings.

2.7 POST AERATION SYSTEM

A. The Modular MBR System Supplier shall provide a minimum of one (1) field-erected Post Aeration System supplied as shown on the plans.

B. Minimum Post Aeration Tank operating volume shall be determined based on required for minimum chlorine contact time of 20 minutes at peak flow.

C. The Post Aeration System shall include the required aeration system, level transmitter, high level switch, low level switch.

D. The Post Aeration Tank shall include the minimum flanges/connections for all required liquid and air connections as well as the required manway or access hatch

E. The Post Aeration Tank shall include a fitting for the Non-Potable Water Supply System, if required.

A. The Post Aeration Tank shall be equipped with an air distribution system to provide 20 scfm per 1,000 cf of basin volume. The fine bubble diffusers shall be located as shown on the drawings.

2.8 NON-POTABLE WATER SYSTEM

B. The Modular MBR System Supplier shall provide a Non-Potable Water System, if required, as shown on the plans.

C. The Modular MBR System Supplier shall supply and install a non-potable water pump system to provide water for the wastewater treatment system. The non-potable water pump system shall have sufficient capacity to provide water for operations throughout the plant.

D. The system shall consist of a minimum of two (2) pumps with controls, a bladder tank, and associated pipe, hose bibs, and hose racks.

2.9 EQUIPMENT BUILDING

A. The Modular MBR System Supplier shall provide an insulated prefabricated building with field-erected power distribution panel, HVAC, and lighting shall be supplied in accordance with local, state, and federal code.

B. The prefabricated building shall include a field-erected bathroom and sink facilities for the duty operator as well as an eyewash station with integrated shower for operator safety.

C. The prefabricated building shall be sized to adequately house the Non-Potable Water System, if required, and store Spare Parts and other materials required by the Utility including but not limited to maintenance tools, mechanical equipment, chemicals, chemical containment, computer equipment and peripherals, telemetry systems, and plant electrical panels as needed.

2.10 SPARE PARTS

A. The Modular MBR System Supplier shall furnish one complete set of manufacturer's recommended spare parts for each piece of equipment included with the Modular MBR System, including, but not limited to:

1. Pumps beyond hardwired spare(s)
    a) Provide one shelf spare pump for each model supplied.
    b) Provide lot of conventional spare and replacement parts for each model supplied.
2. Blowers beyond hardwired spare(s)
    a) Provide one complete blower for each model supplied.
    b) Provide lot of conventional spare and replacement parts for each model supplied.
3. Mixers
    a) Provide one shelf spare mixer for each model supplied
4. Ultraviolet Disinfection System
    a) Provide one full set of spare UV bulbs

B. Furnish a list of spare parts recommended by the MBR System Supplier for the Future Expansion Capacity phase. Adequate spare parts must be provided such that plant operators can replace or repair any malfunctioning equipment that causes a train or treatment unit failure such that the failed train or treatment unit can be restarted within three days.

PART 3 - EXECUTION

3.1 GENERAL

C. All work shall be performed by skilled craftsmen qualified to perform the required work in a manner comparable with the best standards of practice.

D. The Contractor shall provide a supervisor at the work site during all construction operations. The supervisor shall have the authority to sign change orders, coordinate work and make decisions pertaining to the fulfillment of the contract.

E. The Contractor and all workmen employed by him shall conduct all operations in a clean and sanitary manner and in conformance with all aspects of the contract documents.

3.2 COORDINATION

A. The Modular MBR System Supplier shall coordinate the delivery, acceptance, and field erection of all supplied equipment for a complete functioning system.

B. The Modular MBR System Supplier shall provide all required lifting lugs on prefabricated assemblies as well as required fasteners and fittings to simplify handling.

C. The Modular MBR System Supplier shall coordinate the setting of all prefabricated assemblies and ensure they are level and in the correct position.

D. The Modular MBR System Supplier shall install all prefabricated assemblies in the field.

3.3 START-UP

A. The Modular MBR System Supplier shall provide services of the manufacturer's representative as needed to ensure proper installation of equipment and to provide start-up supervision.

3.4 TRAINING

A. Manufacturer shall furnish the services of a factory trained service representative for one trip including two days of operator training. Contractor shall coordinate training to ensure equipment is operational and ready for training and Owner staff is available. Manufacturer shall submit written training agenda to Owner for approval at least seven days prior to training. Manufacturer shall provide written materials describing operation procedure, required maintenance frequency, and installation of spare parts.

B. General Contractor shall include all of Supplier's travel, expense, and coordination costs in bid. Training may be same day as start up.

C. The Contractor shall provide services of the manufacturer's representative to provide training for the operation of the plant and O&M instruction.

3.5 COMMISSIONING PLAN

A. The Modular MBR System Supplier shall provide a detailed, stepwise delivery and commissioning plan for the Engineer's review. The goals of the commissioning plan are to thoroughly inspect the Modular MBR System in a methodical fashion and to provide thorough site-specific training.

B. The setup and or configuration of every component shall be documented on forms complying with the requirements of the Commissioning Plan.

C. Remote monitoring capabilities and report generation shall be verified and accepted by the Owner. Operator feedback and overall readiness shall be documented using Supplier's standard acceptance forms.

D. Minimum Content of the Commissioning Plan:

5. Startup Team
6. PLC/Programming Factory Acceptance Test
7. Mechanical Inspection & System Wet Test (New Unit)
8. Training Session 1
9. System Startup
10. Startup Instructions

b) Site Inspection and System Checkout (no water)

c) System Wet Test (with clean water)

d) SCADA Connectivity & Report Generation Test

e) System Seeding and Beneficial Use

1) Seed the process with the required volume (#,### gallons) of fresh, biologically active sludge at 3,000 mg/l TSS or equivalent. The sludge target VSS is 70% or higher.

2) Demonstrate chemical dosing accuracy and control. Confirm operator understanding of chemical dosing requirements and preparedness.

3) The Modular MBR System shall operate 3 days without a significant interruption in service. Confirm that the Modular MBR System is free from pump or valve cavitation, water hammer, overheating, overloading, vibration, or other operating problems.

4) Perform Membrane Clean in Place (CIP).

5) Place the Modular MBR System in beneficial use, treating wastewater per Operator direction.

f) Training Session 2

g) 30-Day Process Validation Test

h) Post-Commissioning Checkout & Startup Closeout

END OF SECTION

SECTION 04000
CCSUD ELECTRICAL DESIGN CRITERIA

PART 1 - GENERAL REQUIREMENTS

A. The contractor shall maintain service to existing systems at all times during construction. Any work involving power outages, bypass pumping, or any other interruption of flow must be performed between 8:00am and 5:00pm excluding weekends and holidays. All necessary temporary power, bypass pumping, temporary plugs, etc., shall be furnished and performed by the contractor. Coordinate and schedule any such activities with CCSUD at least two (2) weeks in advance.

PART 2 - ELECTRICAL

A. General

1. If enclosures, panels, instrumentation, and controls are not located within a building, electrical equipment shall be mounted on a rack with a shade roof (detail provided upon request). Electrical rack with roof shelter for electrical and control equipment orientation of shelter shall be such that panels face east or north.
2. Electrical work shall be installed in accordance with CCSUD standard details (see attachments).
3. Electrical equipment buildings shall be located between distances of 50' minimum to 150' maximum, from pump motor locations.
4. Engineer to provide complete design drawings and specifications. Drawing package to include site plan, load, calculations, one-line diagrams, schematics, panel layouts, grounding design, etc. Include types, sizes, quantities, and routing of all raceways and conductors. Each duct bank section shall be detailed. Provide interior and exterior layout details, schematics, and in-line diagrams for all control panels and MCCs.
5. All equipment shall be designed to automatically reset after power outages.
6. Main electrical service shall be provided with a Transient Voltage Surge Suppressor (TVSS)/Surge Protection Device (SPD) including overcurrent protection on each leg. Schneider/Square-D(SQ-D) surge protection devices (SPD) shall be provided and located at service entrances.
7. Electrical service shall be 480V 3-phase. Phase converters are not allowed. Requests for smaller electrical service shall be reviewed and considered for approval on a case-by-case basis.
8. Electrical service disconnects shall be enclosed circuit breakers.
9. Provide general use receptacles for temporary loads, power tools, etc. The receptacles shall be located in the electrical room, at the electrical rack, and within 10' from each pump.
10. Electrical panels shall have tinned copper bus and bolt-on type circuit breakers.

11. All surface mounted device boxes shall be FD type sand cast aluminum with 316SS cover screws.
12. All receptacles shall be duplex 120V 20A GFCI-WR. Outdoor locations shall have aluminum while in-use covers.
13. Schneider/SQ-D Mini-Power Centers (MPZ) shall be used at locations where requires for 240/208/120V
14. Schneider/SQ-D electrical panels and appurtenances shall be used throughout locations unless other manufacturers have been approved by CCSUD.
15. Provide type written panel circuit directories in all electrical panels. An as-built laminated one-line diagram shall be located in each electrical room.
16. Use aluminum hardware, struts, and straps. If anchors are necessary, 316SS anchors shall be used. All exterior mounted electrical enclosures and devices shall be mounted on struts.
17. All electrical enclosures shall have black heavy duty plastic labels with white 3/8" block lettering or engraved aluminum labels. Labels shall be attached with aluminum rivets on NEMA 1 panels or for indoor installations only. All instruments shall have round shaped black plastic tags with white 1/4" block lettering or engraved aluminum tags, attached with 316SS cable. Label circuit numbers on all device covers with white adhesive tape type labels with black machine printed 3/16" block lettering. All tags shall be consistent throughout locations. Identification for electrical systems shall be as follows:
    a) Panelboards: identify panel name, ampere rating, voltage, phase, power source and circuit number, and main overcurrent protective device. Provide a typed circuit directory to identify loads served.
    b) Transformers: identify kVA rating, voltage, and phase for both primary and secondary, power source and circuit number, and loads served.
    c) Enclosed switches, circuit breakers, and motor controllers: identify voltage, phase, power source and circuit number, and loads served.
    d) Label each junction/pull box cover plate with the circuit number of the circuits it contains. Label each exiting conduit at the point where it exits the junction box with the circuit number it contains. If the raceway system is in an exposed area label the inside of the junction/pull box cover plate only.
18. Provide ability to operate facility with one pump removed for maintenance, by utilizing a Hand-Off-Auto (HOA) switch and control that alternates remaining pumps in service with no parallel switching. This allows for proper lockout procedures to be followed when performing maintenance.
19. Non-fused disconnect switches, NEMA 4X 316SS type, shall be used at pump locations in lieu of emergency stop switches.
20. Power studies sealed by a professional engineer shall be performed by Schneider/SQ-D or by designated contractors as approved by CCSUD.
    a) Perform analysis of electrical power distribution system using software and data from actual installed equipment and components. Hand calculations are not permitted.
    b) Protective device coordination studies: analyze all known alternate power source scenarios and determine suitable margins between time-current

curves to achieve full selective coordination while providing adequate protection for personnel, equipment, and conductors.

c) Arc flash and shock risk assessment: perform incident energy and arc flash boundary calculations using alternate scenarios to determine the worst-case scenarios to determine the worst-case scenario. Apply arc flash warning labels compliant with ANSI Z535.4 to all equipment components.

d) Provide reports to the Engineer of record and the Owner for all analysis/studies performed.

21. Contractor shall perform operational demonstration testing. Contractor shall startup, test, and verify all equipment is operational prior to scheduling CCSUD to witness demonstration testing. Operator training shall be conducted on a separate day after demonstration testing has been completed. Contractor shall coordinate scheduling with CCSUD at least two (2) weeks in advance.

B. Motor Starters

1. All motors must be driven by variable frequency drives and shall be inverter-duty rated.

2. All full voltage starters shall be NEMA sized, minimum size of 1. Half sized starters and IEC starters are not allowed. These starters shall be provided with solid state overload relays.

3. Yaskawa (Square D) are the allowable manufacturers for Variable Frequency Drives (VFD). The Toshiba VF model VFD, Toshiba H7 VFD, or the Schneider Altivar Process VFD shall be provided for all motors unless determined otherwise by CCSUD. All VFDs shall be supplied with harmonic filters. Manufacturer substitutions are allowed only with written approval from CCSUD.

4. If motors have across the line starters, Siemens or Eaton contractors shall be used.

C. Lighting

1. Provide manually controlled, dark sky compliant, LED site lighting in each process area: 15,000 lumens and 4,000K. Provide intermediate hinged aluminum poles in bronze color; anchors and hardware shall be stainless steel. Provide photocells and receptacles at all light poles. Receptacles shall be located on the light pole base and shall be circuited separately from the light circuitry. Switches shall be located on electrical rack or in electrical room. Where applicable, Cooper # GALN-SA2D-740-U-XX-BZ pole light fixtures shall be used on Valmont Structures light pole base.

2. Interior light fixtures throughout sites shall be vapor tight LED fixtures: 4000 lumens and 4000K.

3. Exterior light fixtures installed on equipment buildings shall be weatherproof LED full cutoff wall pack with photocells and motion sensors. Provided lights shall be wall/surface mount above doors, 4000K and 24W minimum. Cooper # IST-SA1X-740-U-XX-BZ wall pack light fixtures shall be used where applicable.