SECTION 0300 SANITARY SEWER SYSTEMS

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0301 GENERAL REQUIREMENTS

0301.1 ODEQ Design Criteria

Minimum design criteria for all Sanitary Sewer Collection and Treatment Facilities shall be the Title 252, Oklahoma Administrative Code, Chapter 656, Water Pollution Control Facility Construction, latest edition, Oklahoma Department of Environmental Quality (ODEQ).

0301.2 ODEQ Permitting

All plans pertaining to the collection and treatment of public wastewater must be approved by ODEQ. The Developer shall submit six (6) sets of plans, one (1) original ODEQ Engineering Report form and one (1) original of the ODEQ Permit to Construct form to the Engineer for review and approval. Upon approval, the City of Owasso shall stamp the approved submittals and return four sets of plans, a copy of the Engineering Report and the signed ODEQ Permit to Construct form to the Developer. The Developer is responsible for transmitting three sets of plans, the Permit to Construct form, the Engineering Report and the review fee to ODEQ.

0301.3 Maintenance Bond

The construction contractor shall post a Maintenance Bond or Irrevocable Letter of Credit in an amount equal to 100 percent of the determined amount of construction costs for a two-year period after completion and acceptance of all improvements. The bond shqll be written wherein the City is the grantee.

0301.4 City of Owasso Review

The City of Owasso reserves the right to require changes in sewer line alignment, sewer line grade, and manhole placements. Design calculations shall be available for review by the Engineer.

0301.5 City of Owasso Wastewater Collection System Master Plan

The City of Owasso has adopted a Wastewater Master Plan into the City ordinances. Copies are available for review by designers. Sanitary sewer line sizes shall conform to the Wastewater Master Plan (if applicable) and the most recent updates available through the Engineer.

0301.6 Alignment Surveys

Alignment surveys for sewer line projects shall be performed as specified in Section 0110, General; Paragraph 0116.3, Alignment Surveys.

0301.7 Plan Requirements

All construction plans shall comply with Section 0110, General; Subsection 0117, Drafting.

0302 SANITARY SEWER DESIGN

0302.1 Design Flows

A. Sanitary sewer systems shall be designed to comply with the latest version of the ODEQ regulations:

1. Consider the maximum hourly domestic flow, industrial flow, inflow and infiltration and the topography regarding the slope and plumbing needs.

2. Design for an average daily per capita flow of 100 gallons per capita day, assuming three persons per residence (or residential lot) which includes normal infiltration. Peak design flow must be based on an acceptable infiltration/inflow (I/I) study or, for new sewer extensions, the ratio of peak to average daily flow from a widely recognized engineering standard.

3. For industrial and commercial properties, the design engineer shall make the appropriate assumptions to determine design flow. Design calculations shall be provided to the Engineer.

B. The average household size shall be assumed to be 3 persons, so that each lot shall be assumed to produce 300 gpd average. For new sewer extensions, the Engineer has determined that use of the following peaking factors, (which include I/I), is adequate and commonly quoted in engineering standards:

1. A peaking factor of 4 for laterals and submains (pipe diameter less than or equal to 12 inches) and

2. A peaking factor of 2.5 for mains and interceptors (pipe diameter greater than 12 inches). Sewer lines shall carry the peak flow at 1/2 pipe capacity.

C. Exclude storm water from roof drains, streets, and other areas.

D. Other designs parameters: Sanitary sewage systems shall include the following parameters:

1. Maximum hourly quantity of domestic sewage.

2. Additional maximum sewage or waste from industrial plants or high use businesses.

3. Future upstream development of the basin.

0302.2 Sewer Lines

A. Sanitary sewer main and water main separation: In no case shall a sanitary sewer main be designed closer than 2-feet vertically or 10 feet horizontally of a water line, unless the sewer line is installed with pressure rated pipe, sleeved, or encased.

B. Sanitary sewer main and underground storage tank separation: Polyvinyl chloride (PVC) sewer lines shall be located at least 50 feet from any gasoline storage tank, as

measured from the edge of the pipe to the edge of the closest edge of the storage tank. Wherever the 50 feet separation cannot be met, ductile iron pipe shall be used.

C. Sanitary sewer main and other utility separation: Sewer lines shall be located a minimum of 10 feet horizontally from underground electric, oil lines, gas lines, storm sewer, underground cable and telephone lines; 300 feet from any public water supply or 50 feet from a private water well. Deviation from these separation requirements will be reviewed on a case-by-case basis.

D. Line alignment

1. Sewer lines shall be located on the rear of the property served, unless topography requires the location on the front or side of the property. The Engineer will review and may grant a waiver of this standard if required by topography or other factors.

2. The location of sewer lines within the street will be allowed only in limited circumstances and will require written permission from the Engineer.

3. Sewer lines may also be located in perimeter easements that are a minimum of 17.5 feet wide. The sewer line shall be located 12.5 feet inside the property line.

4. Side lot easement widths will be based upon other utilities in the easement and the location and depth of the sewer. Alignment, size, and grade of lines shall be subject to review by the Engineer.

5. Sewer lines shall be designed in a straight alignment and shall be designed with a uniform grade between manholes. Vertical and horizontal curves are not permitted.

6. Where the horizontal alignment deflection angle between the incoming and outgoing pipes at a manhole is equal to or less than 45°, the invert of the downstream pipe shall be 0.10 feet lower than the invert of the lowest upstream line invert.

7. Where the horizontal alignment deflection angle between the incoming and outgoing pipes at a manhole is greater than 45°, the invert of the downstream pipe shall be 0.20 feet lower than the invert of the lowest line invert upstream.

8. Sewer line size changes shall occur at a manhole only. Where a smaller sized line flows into a manhole and exits a larger size line without horizontal deflection, the invert of the larger downstream line shall be 0.10 feet lower than the invert of the smaller upstream line.

9. No horizontal alignment deflection angle between the incoming and outgoing pipes at a manhole shall exceed 90° unless special circumstances exist and it is allowed by the Engineer.

10. Any deviation from the above requirements shall be reviewed by the Engineer.

E. Pipe sizes: The minimum size of sewer mains shall be:

1. Eight(8)-inch diameter in areas where the sewer line can possibly be extended.

2. Twelve (12) inches in diameter where the sewer line could possibly be extended to an area greater than 640 acres.

F. Pipe materials: The City of Owasso requires the following sewer pipe:

1. Polyvinyl chloride (PVC): ASTM D-3034, SDR 35, gravity sewer 8" - 15"

2. Polyvinyl chloride (PVC): ASTM F-679, SDR 35, gravity sewer 18" - 36"

3. Polyvinyl chloride (PVC): ASTM 2241, SDR 26, gravity sewer greater than 12 feet deep but less than 22 feet deep.

4. Polyvinyl chloride (PVC): C900, DR18, gravity sewer greater than 22 feet deep. Pipe greater than 12 inches shall be C905, DR18

5. Polyvinyl chloride (PVC): SDR 26, under pavement (or sleeved PVC SDR 35)

6. Polyvinyl chloride (PVC) exterior-rib pipe conforming to ASTM F794 and UNI-Bell specification UNI-B-9 or ASTM F949-93a.

7. Ductile iron pipe for gravity systems shall be allowed only in limited cases and will require written permission from the Engineer. Ductile iron pipe 8 inches to 15 inches shall conform to ANSI/AWWA C151 or C153. Ductile iron 18 inches or greater shall be ANSI/AWWA A746. Pipe shall have a ceramic epoxy lining.

G. Sewer line grade: All sanitary sewer lines shall be designed to provide a minimum velocity of 2.0 feet/second when flowing full, but not exceed 10.0 feet per second at average flows and 15 feet/second at full flows. The minimum and maximum slopes allowed for sanitary sewer pipe are listed in the following table. The Engineer require slopes greater than the ODEQ minimum in pipes with low flow.

Sewer Line Nominal Diameter	**Minimum Slope @ Full Flow (1 foot/100 feet)**	**Maximum Slope @ Full Flow (1 foot/100 feet)**
8 inches	0.40	19.29
10 inches	0.29	14.34
12 inches	0.22	11.25
15 inches	0.15	8.36
18 inches	0.12	6.56
21 inches	0.10	5.34
24 inches	0.08	4.47
27 inches	0.07	3.83

H. Sewer line depth:

1. Sanitary sewers shall be designed to be no shallower than 36 inches deep.

2. The sewer depth shall be designed great enough to permit extension of the sewer line where such extension is possible or practical.

I. Underground creek crossings and adjacent construction:

1. Cover over sewer lines shall be 36 inches minimum.

2. Sewer line crossings using ductile iron pipe shall be restrained-joint construction with polywrap. The trench shall be backfilled with concrete to an elevation 2 feet above top of pipe through the creek area and extending at least 5 feet into the bank. As an alternate, the line may be constructed with sleeved PVC pipe with a steel casing pipe extending 5 feet into the stream banks. The casing shall be anchored with concrete at each bank.

3. Crossing shall be designed in such a way as not to affect the flow of the stream.

4. As near as possible, crossings shall be made perpendicular to the stream flow.

5. Sewer lines, manholes, and structures designed parallel to a stream shall not be located in the stream flow-line or close enough to effect future stream widening or accumulate debris.

6. Disturbed stream banks shall be returned to the original slope and protected from erosion with concrete slope protection or riprap and fabric.

J. Aerial stream crossings:

1. The bottom of the pipe shall be above the 50-year flood elevation. Any deviation from this requirement must be approved by the ODEQ.

2. Crossings may be constructed with either restrained-joint ductile iron pipe or sleeved PVC pipe. In each case, the pipe or steel casing pipe shall be adequately supported with concrete piers within two feet of joints and anchored at both stream banks. The ductile iron pipe or casing must extend 5 feet into the banks. Expansion joints shall be used at the transition between below ground and above ground pipe.

3. Disturbed stream banks shall be protected with concrete slope protection or 12-inch riprap with fabric.

4. The piers shall be designed so that the top of the footings are at least 2 feet below the bottom of the stream flowline. Supports shall be designed to prevent frost heave, overturning and settlement.

5. Crossings where the bottom of the sewer line is zero to 5 feet above the creek bottom shall be constructed to keep debris from becoming lodged on the pipe.

K. Gravity lines crossing under industrial or commercial collector streets shall be sleeved.

0302.3 Manholes

A. Manholes shall be either pre-cast or cast-in-place, reinforced concrete.

B. Minimum inside diameter shall be 4 feet. The maximum pipe size entering a 4-foot manhole shall be 15 inches. Larger pipe sizes shall require a 5- or 6-foot diameter manhole.

C. Manhole spacing shall be a maximum of 300 feet.

D. Adjustments in manhole spacing may be made to allow locations adjacent to the streets.

E. Where sewer lines are installed in new or existing manholes, 12 inches of separation shall be maintained between the pipes.

F. Shallow manholes shall be specified where the manhole is less than 4 feet deep. Shallow manholes shall be 4 feet in diameter from the bottom to the top of the manhole.

G. Manhole flow channels (inverts) through the manholes shall be semicircular in shape and troweled to a smooth surface. For manholes serving lines with divergent angles between 45- and 90-degrees, the invert trough shall have a 0.1-foot drop to the discharge side. **NOTE**: Where unequal size pipes enter a manhole, the pipes shall be installed without causing backup in the smaller pipe. The elevation of fluid at 0.8 full depth of flow in each pipe should match.

H. Drop manholes shall be specified where the influent line enters a manhole a distance 2 feet above the manhole floor. The drop shall be on the exterior of the manhole and not the interior. The outside drop piping shall be completely concrete encased.

I. Rim elevations for all manholes shall be 1-foot minimum above 100-year flood or water tight, bolt down, gasketed manhole lids shall be installed.

J. Exact manhole rim elevations shall be staked in field.

K. Terminal manholes shall be located within a utility easement and extend approximately 15 feet into the last lot served. In areas where utility congestion prohibits this requirement, the distance may be reduced to 10 feet.

0302.4 Lampholes

In accordance with ODEQ regulations, lampholes shall not be allowed.

0302.5 Connections

A. In-line tees and service risers shall only be installed where needed in order to allow private lines to be connected without future trenching across existing streets. See Standard Detail SAN-09.

B. Tee size and station of the tee from the downstream manhole shall be shown on the plan and profile. The station shall be verified after construction of the lines.

C. The service line grade shall be designed to allow for the following:

1. One percent minimum grade from the structure foundation to the in-line tee on the sewer main.

2. A minimum service line depth of 2.5 feet below finish grade of paving.

3. 1.5-foot drop from the service line to the sewer main.

4. Only one (1) service line and connection shall be installed per lot or structure.

5. Non-standard sewer taps shall be removed, the sewer main repaired, and the tap installed in accordance with the standard details.

6. Tapping to an existing main shall require a PVC saddle.

0303 LIFT STATION DESIGN

Design requirements shall conform to this Section and Standard Detail SAN-11.

0303.1 Codes, Specifications and Standards

Codes, specifications and standards referred to by title or number shall form a part of these standards. Latest revisions shall apply in all cases. Specific reference standards include:

A. Water Pollution Control Construction Standards, Rule No. 655, ODEQ

B. Wastewater Collection Systems Management, MOP 7, 5th Addition, WEF

C. Code of Ordinances, City of Owasso

0303.2 Design Flows

A. Peak flow: The lift station capacity shall be based on the peak flow and not the average daily flow.

B. Service area: Wastewater lift stations shall be designed for total ultimate development in conformance with the Wastewater Management Plan. The average design flow shall be from all contributory areas. Contributions include the immediate gravity system, subsidiary sources, and known or projected future development within the designated station service area.

0303.3 Pump Requirements

A. Capacity: The selected wastewater pump shall have the minimum capability of pumping the design peak flow at the maximum computed system Total Dynamic Head (TDH) requirements.

B. Minimum flows: Minimum design flows for a lift station shall be 200 gpm.

C. Minimum solid size: The selected wastewater pump shall be able to pass a minimum of a 3-inch solid.

D. Duplex lift stations: At least two (2) pumps shall be provided for each lift station with independent piping for all lift stations under 1 MGD. The two pumps shall be identical.

E. Triplex lift stations: Lift stations over 1 MGD shall be equipped with at least three (3) pumps.

F. Standby unit: The lift station shall be able to accommodate the maximum sewage flow with one pump out of service.

G. Cycle time: The cycle time between each successive start shall range from 30 minutes to 3 hours, using average daily flows. The wet well capacity and operational levels shall be designed using the following equation or other approved method:

$$T = \frac{V}{D - Q} + \frac{V}{Q}$$

T = Total time between successive pump starts (min)
D = Rated pump delivery (gpm)
V = volume in wet well between "pump off" and "lead pump on" operating levels. (gallons)
Q = Average daily flow into wet well (gpm)

0303.4 System Head Curves

A. System head curves shall be developed for each pump station and presented to the Engineer with the design calculations. Two curves shall be provided for new systems indicating operational parameters for when the system is new and when the system is 20 years old.

B. The curves shall be prepared on a computer generated graph with the following information:

1. System head shall be plotted on the abscissa (Y-axis) and measured in feet.

2. Flow of the system shall be plotted on the ordinate (X-axis) and measured in both gallons per minute (gpm) and million gallons per day (MGD).

3. The system head characteristics shall be plotted using the friction losses based on Hazen-Williams formula. The Hazen-Williams friction factor for pipe shall be as follows:

Pipe Type	C- Factor
New PVC Pipe	140
Used PVC Pipe	120
New Ductile Iron Pipe	130
Used Ductile Iron Pipe	100

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C. The system head curve shall also take into account any other contributing lift stations to the same force main.

D. Pump curves shall be plotted on the graph. The pump curves shall be: 1) with lead pump on, and 2) the lead and lag pumps on. Lift stations with more than two pumps shall have pump curves for each possible sequence of operation.

E. The efficiency of the pump shall also be plotted on the curve.

F. The pump shut-off head shall be referenced on the graph.

0303.5 Efficiencies

Pumps shall be selected with the best possible operating efficiency. Pumps proposed with efficiencies less than 70% shall be approved on a case-by-case basis.

0303.6 Wet Well Design

A. Materials: The wet well shall be composed of precast or cast-in-place reinforced concrete.

B. Diameter: The diameter of the wet well shall be a minimum of 8 feet. The diameter shall be such that sufficient space is provided for pumping equipment, piping, rails and other necessary amenities.

C. Capacity: Minimum wet well capacity: A minimum of 24 inches shall be provided between the “pump off” elevation and the “lead pump on” elevation.

D. Minimum water level: The minimum water level in the wet well shall be 12 inches above the wet well floor or 6 inches above the top of the pump volute.

E. Maximum level: The maximum water elevation shall not exceed the invert of the lowest gravity sewer line entering the manhole. The high water alarm shall be set at the same elevation as the invert of the lowest gravity sewer entering the manhole.

F. Wet well bottom: The bottom of the wet well shall be designed with fillets sloping from the interior wall face to the pump. The fillets shall be at a 1:1 slope and be constructed of concrete.

G. Anti-floatation: The wet well shall be designed to account for any ground water found on the site or historically present in the area. Where groundwater is present, the wet well shall be designed with either an over-sized base or walls. The wet well shall be designed to overcome the hydrostatic pressure of the groundwater, with a minimum safety factor of 1.5. The following characteristics shall be used:

Reinforced Concrete	-	150 pounds per cubic foot
Groundwater	-	62.4 pounds per cubic foot
Quicksand	-	100 pounds per cubic foot
Safety Factor	-	1.5

H. Access hatches: All wet wells shall be equipped with locking aluminum access hatches, either one or two leaves that are designed to allow adequate working space and allow the pumps to be removed without modifications to the wet well. Hatches shall be fitted with alarm entry contact switches compatible with the SCADA system.

I. Ventilation: All wet wells shall be vented to allow gases to expel to the atmosphere. The minimum size vent shall be 4 inches and shall be designed with flanged ductile iron pipe and elbows. An insect screen shall be placed between the elbow flanges. All dry wells shall be provided with either continuous or intermittent ventilation. Continuous ventilation shall provide at least 6 complete air changes per hour. Intermittent ventilation shall provide at least 30 air changes per hour. Ventilation equipment switches shall be marked and located at the entrance to the dry well. All intermittently operated ventilating equipment shall be interconnected with the respective pit lighting system. A two-speed fan shall be tied to the light switch such that, when the light is turned on, the system automatically operates at 30 changes per hour and switches to 6 changes per hour after 10 minutes. The fan wheel shall be fabricated from non-sparking material.

J. Piping: All piping in the wet well shall be flanged ductile iron. All penetrations through the wet well wall shall be leak proof.

K. Rail system: The pumps shall be installed and removed using a rail system designed by the pump manufacturer. The rails shall be rigid after installation. Intermediate supports shall be designed to keep the pumps from derailing during installation or removal.

L. Influent manhole: An influent manhole shall be provided within 25 feet upstream of the wet well. All of the branch sewer mains shall flow into this manhole. The influent manhole shall be connected to the wet well with a single sanitary sewer influent pipeline. A gate valve with a dedicated stem riser shall be located on the single influent pipeline to allow workers to enter the wet well safely. The gate valve shall be located within a security fence and provided with a locking lid.

M. Security fencing: An 8-foot-tall chain link security fence shall be provided. A 4-foot-wide gate for pedestrian access and a 12-foot-wide (2-leaf) gate for maintenance vehicle access shall be provided. The gate shall be fitted with a contact alarm switch compatible with the SCADA system.

0303.7 Valve Vault

A. Materials: The valve vault shall be precast reinforced concrete pipe or cast-in-place reinforced concrete.

B. Diameter: Valve vault shall be a minimum 5 feet in diameter. Piping shall have at least 24 inches of separation, as measured from the exterior walls of the piping. Piping shall also be installed at least 12 inches from the interior concrete walls.

C. Valve vault bottom: The bottom shall be sloped to the interior wall face nearest the exterior wall of the lift station wet well. A sump shall be installed with a 2-inch PVC drain line to the wet well. The drain end line shall be designed with a check valve.

D. Piping: All piping in the valve vault shall be flanged ductile iron pipe.

E. Valving: Valves in the valve box shall have a separate plug valve and check valve for each pump. The plug valves shall be handwheel operated. Taps and pressure gauges shall be provided at strategic locations to insure operation of valves.

F. Access hatches: All valve vaults shall be equipped with locking aluminum access hatches, either one or two leaves, that are designed to allow adequate working space and allow the valves to be removed without modifications to the valve vault. Hatches shall be fitted with alarm entry contact switches compatible with the SCADA system.

G. Emergency pump connection: Emergency pump connections shall be installed on the piping in the valve vault with an isolation valve. A 4 inch male "Cam- Loc" coupling shall be installed on piping extending through the top of the valve vault.

H. Flow monitoring/flow indication: Magnetic flow meters shall be installed on the piping of each valve vault. A recorder totalizer shall be installed in the control panel.

0303.8 Controls

A. Lift station controls shall consist of a telemetry package for monitoring purposes including a remote terminal unit, modems, radios, network devices, cables, and any antenna tower requirements. All components must be suitable for continuous operation in the existing environment including suitable protection devices. The package must contain its own standby power battery system and charger. Monitoring points shall include:

Pump run	Pump flow	Seal fail	High temp
AC power fail	Generator run	Pump run time	High wet well
High dry well	Tamper/intruder detect		

B. All controls shall accept Form C dry contact inputs and be compatible with the City's SCADA system.

C. All pumps shall be fitted with dry contact over-temp readout, variable-frequency drive signal and breaker tripped contacts.

D. Controls shall be designed to give the City of Owasso as much flexibility as possible.

E. Level controllers shall be mercury switches.

0303.9 Electrical

A. Automatic control center shall be equipped with individual disconnects, 3-pole manual transfer switch, 4-pole standby generator receptacle to match generator plug,

across-the-line starters, alternator, automatic transfer to non-operating pump in event of overload in operation pump, motor overloads complete with isolated contact for telemetering, overload reset, hand-off-automatic pump operation selector switch, 120 volt transformer for alarm light and duplex 120 volt convenience outlet, a normally closed for high-level alarm, motor fail (2) and motor run (2), all components housed in NEMA 4 dead front construction for pole mounting enclosures. A spare single pole 20A circuit breaker shall be provided to power telemetry panel (TP). 120 VAC power shall be brought to the terminal board in addition to alarm and motor run signals. A thermostatically controlled heater and lightning protection will also be included in the motor control center. Also furnish and install four liquid level sensors consisting of mercury switches in a smooth, chemical resistant polypropylene casing, suspended on its own cable. The control center shall be installed in a location as shown on the drawings. Control panel shall be provided with a keyed locking arrangement. No splicing of electrical cables shall be permitted. All cables and wires must terminate inside the control panel.

B. Electrical systems shall conform to the National Electric Code (NEC).

C. Separate disconnects shall be installed for each pump.

0303.10 Hoist

All lift stations shall be designed with an electrically-operated hoist for pump removal. The hoist shall be capable of lifting the weight of the largest pump with a safety factor of 2. The main voltage will be as required for the service location and power voltage not more than 115/1/60. For pumps less than 20 horsepower, hoists shall be mounted on a pedestal type jib crane with a 360 degree rotation, rotation stops and a manual trolley. The jib crane shall be of sufficient height and span to access removal of all pumps. For pumps 20 horsepower and larger, hoists shall have a motorized trolley mounted from a monorail beam centered over the operations area. Equipment shall be designed for outdoor use and be similar or equal to that manufactured by Americrane and Hoist, LLC, or Gaffey, a division of Crane Equipment Services.

0303.11 Reserve Power

A. Lift stations shall be equipped with a reserve power generator.

B. The engine powered generator shall be operated with natural gas, if available.

C. The generator shall be designed to automatically start and operate the pumps(s) and other equipment in the lift station under design flow conditions.

D. The generator shall be equipped with a weather-tight removable cover.

E. The generator shall be fitted with a power fail contact and a “generator RUN” contact compatible with the SCADA system.

0303.12 Comminutors and Bar Screens

Where required, mechanically cleaned bar screens and comminutors shall be designed to reduce the amount and size of solids entering lift stations.

0303.13 Variable Speed Pump Control System

Variable frequency drives (VFD) may be required on larger pump stations. Each lift station proposal shall be reviewed on a case-by-case basis. The VFD pump controls must provide status signals to the SCADA system.

0303.14 Alarms

A. Lift stations shall have a visual and audible alarm.

B. They shall activate under the following conditions:

1. When the water level rises above the invert of the lowest gravity sewer entering the manhole.

2. When the lead pump is called for and does not respond.

0303.15 SCADA System

A. Lift station operation is monitored via an integrated remote system with readout panels located at the Wastewater Treatment Plant. All installed equipment shall be fitted with alarm and status readouts compatible with the SCADA system.

B. The design engineer shall coordinate with the Owasso Public Works Department to allow reconfiguration of the SCADA system main computer in order to allow the following conditions to be alerted at the wastewater treatment plant.

1. When the water level rises above the invert of the lowest gravity sewer entering the manhole.

2. When the lead pump is called for and does not respond.

3. When the lag pump(s) are called for and does not respond.

4. When the control panel is entered illegally.

5. When primary power is lost.

6. When the reserve power source is called for and does not respond.

0304 FORCE MAIN DESIGN

0304.1 Design Criteria

A. Minimum velocities: The minimum velocity for the force main shall be 2 feet/sec.

B. Minimum force main size: The minimum force main size shall be six (6) inches.

C. Maximum velocity: The maximum velocity for force mains 6 inches to 8 inches in diameter shall be 10 feet per second. Maximum velocity for force mains over 8 inches in diameter shall be 15 feet per second.

D. Pipe materials:

1. Ductile iron (DIP): All DIP force mains shall be lined with Protecto 401 Ceramic Epoxy lining with a minimum thickness of 40 mils. The pipe and fittings shall have an exterior bituminous coating conforming to ANSI/AWWA A21.51/C151 and ANSI/AWWA A21.10/C110. Pipe shall meet AWWA C-151 and the following pipe classes:

Size Range	Pressure Class
12" and smaller	350
14" to 20"	250
24"	200
30" and larger	150

2. Polyvinyl Chloride (PVC): All PVC force mains less than 12 inches in diameter shall meet the requirements of AWWA C900, Class 150, DR18. Pipe greater than 12 inches shall meet AWWA C905, Class 200, DR21.

E. Force main extending under paved areas shall be sleeved.

0304.2 Force Main Termination

Where a force main terminates into a structure, the influent shall be no more than 2 feet from the bottom of the structure.

0304.3 Force Main/Water Line Separation

Force mains shall not be located within 10 feet of a water main as measured horizontally from the outside of each pipe. Vertical separation shall be a minimum of 24 inches, measured as stated above.

0304.4 Depth

A. Minimum depth: The minimum force main depth shall be 36 inches from the top of the pipe to the top of the natural ground elevation. Deeper depths may be required in special cases.

B. Maximum depth: The maximum depth of a force main shall be 8 feet from the top of the pipe to the top of the natural ground elevation, unless otherwise approved by the Engineer.

0304.5 Valves

A. Check valve(s) shall be installed in the horizontal piping of the force main valve box.

B. Sewage air relief valves shall be installed at the high points along the force main.

0305 APPLICABLE STANDARD DETAILS

SAN-01 Sanitary Sewer Pipe Installation

SAN-02	Sewer Pipe Table
SAN-03	Precast Manhole/Drop Manhole
SAN-04	Cast-in-Place Manhole
SAN-05	Manhole Steps & Invert Details
SAN-07	Sanitary Sewer Manhole Pipe Connector
SAN-08	Water Table Cradle for Flexible Pipe
SAN-09	Sanitary Service Line Under Pavement
SAN-10	Sanitary Sewer Service Riser
SAN-11	Lift Station

END OF SECTION

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