

**SECTION 33 09 30
INSTRUMENTATION AND CONTROLS**

PART 1- GENERAL

1.1 SECTION INCLUDES

- A. Installation of instrumentation and controls
- B. Drawings and General Provisions of Contract, including General and Special Conditions, apply to this section.

1.2 DEFINITIONS:

- A. Control System: The primary panel through which the primary functions of the treatment process are controlled.
- B. Sensors: Electronic devices used to measure some aspect of operation.

1.3 RELATED SECTIONS

- A. Section 01 33 00 – Submittals
- B. Section 26 05 01 – Electrical General Provisions
- C. Section 46 51 00 – Blowers and Aeration Equipment
- D. Section 46 43 00 – Supernatant Withdrawal System

1.4 SUBMITTALS

- A. Submittal shall conform to Section 01 33 00.
- B. Electrical Schematics: Submit fabricator's shop drawings and obtain approval before shipping.

1.5 JOB CONDITIONS

- A. Testing Sequence:
 - 1. Notify Owner's Representative of readiness to begin test at least 72 hours before test will start.
 - 2. Test to be commenced in the presence of the Owner's Representative.
- B. System Activation:
 - 1. The product provider, and/or their representative, will perform commissioning and testing of the control system and instrumentation.
 - 2. Upon successful completion of the tests, and approval of the Owner's Representative, the Owner will acknowledge successful commissioning.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Control System
 - 1. The control system shall perform as an integrated component and provide the required operating cycles as described.
 - 2. The control system design shall meet all regulatory and safety guidelines as applicable to federal and state law.

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3. The control system shall consist of a digital operator interface and feature pilot controls for manual operation of blowers and plug valves.
 4. The controller shall regulate the operations of all mechanical equipment including, at a minimum, supernatant withdrawal valve assemblies, blower function, and sludge wasting.
 5. The system shall be based on a four hour operating cycle and follow the sequence and duration provided.
 - a. Hour 1 – Blowers operating and supernatant withdrawal valves closed – (Aeration and Mixing)
 - b. Hour 2 – Blowers operating and supernatant withdrawal valves closed – (Aeration and Mixing)
 - c. Hour 3 – Blowers idle and supernatant withdrawal valves closed – (Biomass Settling)
 - d. Hour 4 – Blowers idle and supernatant withdrawal valves open – (Supernatant Withdrawal)
 6. The blower operating cycle shall be for the blower to run continuously starting in hour 1 through the duration of hour 2, there is no pause in blower operation between these two cycle events.
 7. A water level sensor shall be used to set the operational low water level and to determine operational high water level and flood water level.
 8. The supernatant withdrawal assemblies shall be purged with compressed air for a duration to be programmed by the Operator before entering supernatant withdrawal mode.
 9. An air-lock release valve shall open during the supernatant withdrawal mode to allow air to be released from the assemblies.
 10. System shall incorporate two (2) automatic high flow cycles in the control for extended peak flow.
 - a. If water level exceeds operational high water level then cycle shall be modified to 1 hour Aeration and Mixing, 0.5 hour Biomass Settling, and 1 hour Supernatant Withdrawal. The system shall continue to operate under the modified cycle time until the operational low water level is reached.
 - b. If water level exceeds the flood stage of the reactor the blowers shall immediately shut down (if in operation), Biomass Settling shall commence for a duration not to exceed 0.5 hour (time shall be applied if reactor is in Settling Mode), and Supernatant Withdrawal shall occur until water reaches operational low water level.
 11. Parameters (i.e., timing and duration) of sludge wasting shall be programmable by the Operator and should include the option for manual control.
- B. Flow Meter (Sludge Wasting)
1. Flow Meter shall be Non-Contacting Flow Meter, Doppler Flow Meter Model DFM 5.1 as manufactured by Greyline Instruments, or equal. Meter shall include all components necessary for complete installation:

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- a. Flow Meter
 - b. NEMA 4X Enclosure
 - c. Flow Sensor with stainless steel mounting kit.
 - d. Sensor Cable – length as necessary to mount with other instrumentation and controls. Provide and install junction boxes as necessary.
- C. Probes
- 1. A liquid level sensor shall be installed in the first cell reactor by attaching the probe to one of the two supernatant withdrawal devices.
 - 2. An analytical transmitter will be used to collect data from the probes and, when applicable, transfer signals to the system controls.
 - 3. Any probe(s) and analytical transmitter(s) not specifically named as preferred may be used only with approval by the process provider.
- D. Convenience Outlets
- 1. Control Panel shall include 2 15 amp convenience outlets.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Electrical, General shall be completed to rough in as per Section 26 05 01.
- B. Supernatant Withdrawal System shall be installed as per Section 46 43 00

3.2 INSTALLATION

- A. Sensors:
 - 1. Probes to be installed based on OEM recommendations, process provider drawings, and commonly accepted industry best practices.
 - 2. Care must be taken to protect probes and sensors once delivery has been received and after installation until water in the basin is at operational level.
- B. Control System:
 - 1. The control system shall consist of a NEMA panel and shall be delivered as a complete panel or as modular panel components.
 - 2. The control system / panel shall accommodate and serve as distribution point for all power, conductors, and control wiring for the project.
 - 3. Exception: Control wiring for UV Disinfection System shall be at the UV Control Panel.
 - 4. The control system shall be installed by an electrician licensed in the State of Missouri.

3.3 WIRE AND CONDUIT

- A. Electrical conductors and control wiring shall be run from the control system to functional components (e.g., valves, sensors, blowers, etc.) or junction boxes without breaks or splices.

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- B. Conduit typical of industry standards shall be provided for wiring outside of the control system or junction boxes.

END OF SECTION 33 09 30

**SECTION 33 30 00
SANITARY SEWERAGE**

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Gravity sanitary sewers and appurtenances including submittals, materials, material tests, manholes, pipe, installation of pipe and appurtenances, and testing
- B. Drawings and General Provisions of Contract, including General and Special Conditions, apply to this section.

1.2 RELATED SECTIONS

- A. Section 01 33 00 – Submittals
- B. Section 31 23 33 – Trenching and Backfilling

1.3 SUBMITTALS

- A. Manufacturer's specifications and/or catalog data listing for pipe, manhole steps, covers and frames, and other special items.
- B. Shop drawings showing reinforcing steel details, structural steel details, structural steel supports, and mechanical details for structures and specialty items.
- C. Pipe manufacturer's installation instructions.
- D. Material and pressure test certifications.
- E. Such other information as the Owner's Representative may request.

1.4 PRESENCE OF UNDERGROUND UTILITIES

- A. If utility services are encountered, the Contractor is responsible to have the services relocated if necessary or repaired if damaged.
- B. If a main line utility is in direct conflict to the proposed work, the Contractor shall report the conflict to the Owner's Representative immediately. The Owner's Representative will advise the Contractor how the conflict will be resolved.
 - 1. A direct conflict is defined as the existing utility occupying the exact location that the sewer is to be laid.
 - 2. Relocation and/or support of utilities which are near the sewer location, but not in direct conflict, shall be considered incidental to the sewer work. It is the Contractor's responsibility to arrange and pay for such relocation or support.

1.5 JOB CONDITIONS

- A. Existing Wastewater System: The Contractor shall maintain operation of the existing wastewater system during construction.
- B. Scheduling:
 - 1. Backfill, grading, and clean up shall be no more than 200 feet behind the location of the pipe placement.
 - 2. The Contractor shall maintain trenches for settling.

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1.6 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

- A. No direct measurement of work will be made under this item. All labor and materials shall be included in the appropriate bid items.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Pipe:

1. The Contractor may select particular pipe material for a project from the below listed table, unless specified on the Drawings or in the Bid Documents. These pipe specifications shall govern when cover is 16' or less.
2. Plastic Pipe: Provide seating marks where couplings are used for jointing.

PIPE CLASSIFICATION TABLE
Design Classification by Depth of Cover

<u>Type and Size</u>	<u>Size Limitations</u>	<u>Pipe Material Spec</u>	<u>Joint Spec</u>
Plastic PVC	4"-6"	ASTM D2665	ASTM D3212 or D2672
Plastic PVC	8"-15"	ASTM D3034-SDR35	ASTM D3034, Type 1, Grade 1
Plastic (PE)	6"- 24"	ASTM D3034-SR100	ASTM D2239
PS-46 (PVC)	None	ASTM F789	ASTM D3132
A2000 PVC	None	ASTM F949	ASTM D3132
Ductile Iron	None	ANSI / AWWA C151 / A21.51 Pressure Class 350	ANSI / AWWA C111 / A21.11

B. Manholes (or similar precast structures):

1. Manholes will be precast units and shall conform to ASTM C478 or ASTM C76 Class III.
 - a. Joints shall meet ASTM C361 or ASTM C443.
 - b. Pipe openings shall be provided with flexible connectors designed to produce a positive watertight connection for pipes entering the manhole. These connectors shall be A-LOK produced by A-LOK Products Inc. or equal.
2. Grade rings shall conform to ASTM C478.
3. Waterproofing will be required for all manholes. The bitumen shall consist of two coats of asphaltic pitch. Asphalt shall conform to the requirements of ASTM D449.
4. Prior to backfilling, lift holes shall be fully grouted and/or plugged. Waterproofing shall be field applied in accordance with Item 3 above.
5. Manhole Castings:
 - a. Standard frame and lid shall be Neenah R-1764, Deeter 1270, or equal.
 - b. Watertight frame and lid shall be Neenah R-1916-F, Deeter 1247 B, or equal.
6. Manhole steps shall be Neenah R-1980-J, Deeter 1606, M. A. Industries PS2-PF, or equal.

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PART 3 - EXECUTION

3.1 ALIGNMENT AND GRADE

- A. Before installation of new sewer facilities, verify sizes, measurements, type, and location of existing piping, and appurtenances at points of connection to existing system. If a deviation from the Drawings is found, the Contractor shall notify the Owner's Representative and obtain instruction on how to proceed.
- B. Line and grade control shall be done with a laser beam. The Contractor shall spot check the accuracy of the laser beam in accordance with the following requirements:
 - 1. Elevation shall be checked at the set up point, 25' point, 50' point, 100' point, and 100' intervals thereafter to the next set up point.
 - 2. Projector shall be advanced and reset at each manhole with 600' maximum distance prior to advancement.
 - 3. Grade shall be checked with a rod and level at each checkpoint.
 - 4. Pipe ventilation shall be provided, to prevent beam refraction.

3.2 BEDDING

- A. Bedding shall be provided and extend 6" below and to the spring-line for concrete and ductile iron pipe. Bedding for PVC, plastic, and ABS shall be to 6" above the top of the pipe. Bedding shall be uniformly placed and hand tamped below the haunch area of the pipe.
- B. Granular material for pipe bedding shall be crushed rock or 3/4" clean stone.
- C. The entire length of the pipe barrel shall be supported evenly.

3.3 PIPE INSTALLATION

- A. Work shall be done in accordance with the following standards: ASTM D2321; Underground Installation of Flexible Thermal Plastic Sewer Pipe, AWWA C600; Installation of Cast Iron Water Mains.
- B. Pipe shall be laid commencing at downstream end of line and install pipe with spigot or tongue end downstream. Provide bell holes at each pipe joint to allow barrel of pipe to support trench load.
- C. Use no defective pipe; check each length for defects and hairline cracks at ends prior to lowering into trench.
- D. Place pipe in trench in sound, undamaged condition using chains or straps. Lifting holes will not be allowed except for the manholes.
- E. Clean the interior of all pipe fittings and joints prior to installation. Exclude entrance of foreign matter during installation. Close open ends of pipe with snug fitting closures. Include provisions to prevent flotation should trench fill with water. Remove water, sand, mud, and other undesirable materials from trench before removal of cap.
- F. Install pipe only when conditions are suitable. Do not lay pipe in water or water filled trench.
- G. Pipe shall not be placed on frozen subgrade. Backfill material shall not be frozen.

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- H. Except where pipe sections are being encased in concrete, no pipe is to be supported by blocks or other means.
- I. Pipes installed on grades in excess of 20% shall be anchored securely with concrete anchors spaced as follows:

<u>Grade</u>	<u>Maximum Anchor Spacing</u>
20% - 35%	36'
35% - 50%	24'
Greater than 50%	16'

J. Cutting Pipe:

- 1. Pipe shall be cut in a neat and workmanlike manner to provide an even surface, perpendicular to the pipe centerline.
- 2. All bumps and irregularities shall be removed prior to pipefitting.
- 3. Bevel ends of push-on type pipe.

K. Jointing:

- 1. The gasket position shall be verified prior to compressing the pipe joint together.
- 2. Only those solvents, adhesives, and lubricants furnished by the pipe manufacturer shall be permitted.
- 3. Perform push-on joint installation per manufacturer's instructions.
- 4. Junctions with other materials shall require the use of adapter type and technique recommended by pipe manufacturer.

- L. All ductile or cast iron pipe and fittings shall be poly-wrapped.

3.4 MANHOLES

- A. Manholes shall be constructed in accordance with the drawing detail.

B. Bases:

- 1. A cast-in-place base may be poured on undisturbed, frost-free, dry subgrade.
- 2. If a precast base is utilized, it shall be placed on crushed limestone with a full and even bearing.
- 3. If unsuitable base material exists, the contractor shall remove the unsuitable material and replace it with 3/4" clean rock or other suitable material compacted to provide a bed with full and even bearing.

C. Casting Setting:

- 1. Existing Pavement: In asphalt or concrete pavements, or gravel drives / parking areas, set the manhole ring and lid to match the finished grade.
- 2. Gravel Roadway Surfaces: Set the ring and lid 4" below finished grade surface.
- 3. Unpaved Areas: Match finished ground elevation, unless otherwise noted.

- D. Waterproof the outside surface of manholes with two coats of bitumen material. The bitumen wall shall consist of asphaltic pitch conforming to the requirements of ASTM D449.

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3.5 FIELD QUALITY CONTROL

A. General:

1. The Contractor shall maintain his work site in a manner that will be fully accessible by the Owner's Representative for observation of the work.
2. The Contractor shall conduct the leakage test promptly following installation of wastewater pipe. This test shall include services that have been constructed.
3. The Contractor shall notify the Owner's Representative 48 hours before conducting the leakage test so that the Owner's Representative can schedule inspection and observation of the test.
4. The Contractor shall provide all equipment and conduct the test.

B. The following drift from proposed alignment between structures is as follows:

1. Horizontal Alignment:

- a. Through 36" Diameter Pipe: 0.20'
- b. Over 36" Diameter Pipe: 0.40'

2. Grade:

- a. Through 36" Diameter Pipe: 0.02'
- b. Over 36" Diameter Pipe: 0.05'

C. Plastic Pipe Deformation: In addition to leakage tests, a deformation test will be done as follows:

1. The test shall be conducted not less than one month (30 days) after backfill has been properly installed.
2. The maximum allowable deflection shall not exceed 5% of the pipe's internal diameter.
3. Mandrel testing shall be performed on 100% of the pipeline.
4. Mandrels shall be "Wortco 9-Arm Mandrel" (5% deflection) for flexible or semi-rigid pipe or approved equal.
5. Gauge shall be pulled through the pipe by hand. Mechanical pulling assistance is not permitted.
6. If any section of pipe does not conform to this requirement, the Contractor shall replace it at no cost to the Owner. Leakage re-testing and mandrel re-testing shall take place 30 days after backfilling.
7. The Owner may, prior to the end of warranty (guarantee period), conduct another deflection test. The Contractor at no cost to the Owner shall replace any pipe not conforming to this requirement. The Contractor shall provide an additional warranty (guarantee) of one year for that portion of the replaced pipeline.

D. Leakage:

1. General:

- a. Contractor shall clean pipe of excess mortar, joint sealant, and other dirt and debris prior to inspection.

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- b. Sewer will be inspected by flashing a light (lamping) between manholes and/or by physical passage where space permits.
 - c. The Owner's Representative will determine from illumination and/or physical inspection the presence of visible infiltration or other defects.
 - d. Defects shall be corrected prior to conducting leakage tests.
2. Leakage test shall be done either by a water exfiltration test or air exfiltration test.
- a. For water tests, the allowable exfiltration shall be less than 100 gallons per inch of ID per day per mile per 24 hours (0.08 gallons per inch of internal diameter per hour per 100' of pipe length).
 - b. For air exfiltration tests, the holding time shall not be less than that listed in the table at the end of this Section.
 - c. The Contractor may use air exfiltration testing for pipes of all sizes.
 - d. The Contractor shall perform water exfiltration tests on manholes and may perform water exfiltration tests on sewer pipe larger than 18" ID.
3. Any sections of pipe not meeting the test requirements shall be repaired and the test shall be repeated until work is acceptable.
- a. The Contractor is encouraged to pretest the pipes prior to notifying the Owner's Representative and formal testing.
 - b. For any section of pipe not passing the test when requested by the Contractor, the Contractor shall be responsible for the total cost of re-inspection. The Owner reserves the right to deduct the cost of re-inspection from the Contractor's payment for the work.
- E. Exfiltration Test (Water)
1. The Contractor shall furnish all labor, equipment, tools, and materials required including bulkheads, water, and miscellaneous items to perform the test.
 2. Perform all tests for lines at a minimum water depth 2' above the high point of the system or 2' above ground water elevation, whichever is higher. Perform tests at a minimum water depth of 2' above casting elevation for manholes.
 3. Tests shall be maintained to locate all leaks, but not less than two hours. The Owner's Representative shall confirm measurement of exfiltration amounts.
 4. Tests shall be repeated after repair of leaks and defects, until leakage meets the requirements of this specification.
 5. Manholes and other structures shall be protected by means of bulkheads to prevent bursting pressure from being applied inside the structure.
 6. Pipe shall be de-watered upon completion of the successful test.
- F. Exfiltration Test (Air)
1. In the areas where ground water is known to exist, the Contractor shall install a 1/2" diameter capped pipe nipple approximately 10" long through the manhole wall on top of one of the sewer lines entering the manhole.

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- a. Install at the time the sewer line is installed.
 - b. Immediately prior to the line acceptance test, determine the ground water level. Remove the pipe cap, blow air through the pipe nipple into the ground to clear it, and then connect a clear plastic tube to pipe nipple.
 - c. The hose shall be held vertically and measurement of height of water, in feet, shall be taken after the water stops rising in this plastic tube.
 - d. The height shall be divided by 2.3 to establish the pounds of pressure that will be added to all readings.
2. Contractor shall furnish all facilities required including necessary piping connections, test pumping equipment, pressure gauges, bulkheads, regulators to avoid over-pressurization, and all miscellaneous items required.
- a. The pipe plug for introducing air to the sewer pipe shall be equipped with two taps. One tap will be used to introduce air into the line being tested, through suitable valves and fittings, so that the input air may be regulated. The second tap will be fitted with valves and fittings to accept a pressure test gauge indicating internal pressure in the sewer pipe. An additional valve and fitting will be incorporated on the tap used to check internal pressures so that a second test gauge may be attached to the internal pressure tap. Pressure test gauge will also be used to indicate loss of air pressure due to leaks in the sewer line.
 - b. The pressure test gauge shall meet the following minimum specifications:
 - (1) Size (diameter) -- 4-1/2".
 - (2) Pressure Range -- 0 to 15 psi.
 - (3) Figure Intervals 1 psi. increments.
 - (4) Minor Subdivisions -- 0.05 psi.
 - (5) Pressure Tube Bourdon 2 or diaphragm; Accuracy -- +/- 0.25% of maximum scale reading.
 - (6) Dial white coated aluminum with black lettering, 270° arc and mirror edge.
 - (7) Pipe Connection - low male, 1/2" NPT.
 - c. Calibration data will be supplied with all pressure test gauges. Certification of pressure test gauge will be required from the gauge manufacturer. This certification and calibration data will be available to the Owner's Representative whenever air tests are performed.
3. Test each reach of sewer pipe between manholes. Test at the completion of the installation of pipe and appurtenances and the backfill of the sewer trench.
4. Plug ends of line, cap, or plug all connections to withstand internal pressure. One of the plugs provided must have two taps for connecting equipment.
- a. After connecting air control equipment to air hose; monitor air pressure so that the internal pressure does not exceed 5 psig.

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- b. After reaching 4 psig, throttle the air supply to maintain between 4 and 3.5 psig for at least two minutes in order to allow equilibrium between air temperature and pipe walls. During this time, check all plugs to detect any leakage.
 - c. If plugs are found to leak, bleed off air, tighten plugs, and re-pressurize. After the temperature has stabilized, the pressure is allowed to decrease to 3.5 psig.
 - d. At 3.5 psig, begin timing. Measure the time for air pressure to drop to 2.5 psig. If the time in seconds for the air pressure to decrease from 3.5 psig to 2.5 psig is greater than the time shown in the table at the end of this section, the pipe shall be presumed free of defects.
- G. If the air test fails to meet the above requirements, repeat test as necessary after all leaks and defects have been repaired. Prior to acceptance, all constructed sewer lines shall satisfactorily pass the low-pressure air test or the exfiltration test.

3.6 ADJUSTING AND CLEANING

- A. General: Pipe and structures shall be kept clean as work progresses.

SECTION 33 30 00
SANITARY SEWERS

TABLE 1
MINIMUM TIME REQUIRED FOR A 1.0 psig PRESSURE DROP FOR SIZE AND LENGTH
OF PIPE INDICATED FOR Q = 0.0015 (CFM/SF INTERNAL SURFACE AREA)

Pipe Diameter, (in.)	Minimum Time, (min:sec)	Length for Minimum Time, (ft)	Time for Longer Length, (sec)	Specification Time for Length (L) Shown, (min:sec)										
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft			
4	3:46	597	0.380 L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	0.854 L	5:40	5:40	5:40	5:40	5:40	5:40	5:40	5:40	5:40	5:40	5:40
8	7:34	298	1.520 L	7:34	7:34	7:34	7:34	7:34	7:34	7:34	7:34	7:34	7:34	7:34
10	9:26	239	2.374 L	9:26	9:26	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48	17:48
12	11:20	199	3.418 L	11:20	11:20	11:24	11:24	11:24	14:15	17:05	19:56	22:47	25:38	25:38
15	14:10	159	5.342 L	14:10	14:10	17:48	17:48	17:48	22:15	26:42	31:09	35:36	40:04	40:04
18	17:00	133	7.692 L	17:00	19:13	25:38	25:38	25:38	32:03	38:27	44:52	51:16	57:41	57:41
21	19:50	114	10.470 L	19:50	26:10	34:54	34:54	34:54	43:37	52:21	61:00	69:48	78:31	78:31
24	22:40	99	13.674 L	22:47	34:11	45:34	45:34	45:34	56:58	68:22	79:46	91:10	102:33	102:33
27	25:30	88	17.306 L	28:51	43:16	57:41	57:41	57:41	72:07	86:32	100:57	115:22	129:48	129:48
30	28:20	80	21.366 L	35:37	53:25	71:13	71:13	71:13	89:02	106:50	124:38	142:26	160:15	160:15
33	31:10	72	25.852 L	43:05	64:38	86:10	86:10	86:10	107:43	129:16	150:43	172:21	193:53	193:53
36	34:00	66	30.768 L	51:17	76:55	102:34	102:34	102:34	128:12	153:50	179:29	205:07	230:46	230:46

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TABLE 2
MINIMUM TIME REQUIRED FOR A 0.5 psig PRESSURE DROP FOR SIZE AND LENGTH
OF PIPE INDICATED FOR Q = 0.0015 (CFM/SF INTERNAL SURFACE AREA)

Pipe Diameter, (in.)	Minimum Time, (min:sec)	Length for Minimum Time, (ft)	Time for Longer Length, (sec)	Specification Time for Length (L) Shown, (min:sec)									
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft		
4	1:53	597	0.190 L	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53
6	2:50	398	0.427 L	2:50	2:50	2:50	2:50	2:50	2:50	2:50	2:50	2:50	2:50
8	3:47	298	0.760 L	3:47	3:47	3:47	3:47	3:47	3:47	3:48	4:26	5:04	5:42
10	4:43	239	1.187 L	4:43	4:43	4:43	4:57	5:56	6:55	7:54	8:54	9:58	10:58
12	5:40	199	1.709 L	5:40	5:40	5:42	7:08	8:33	9:58	11:24	12:50	14:26	15:52
15	7:05	159	2.671 L	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02	22:16	24:30
18	8:30	133	3.846 L	8:30	9:37	12:49	16:01	19:14	22:26	25:38	28:51	32:04	35:17
21	9:55	114	5.235 L	9:55	13:05	17:27	21:49	26:11	30:32	34:54	39:16	43:38	47:59
24	11:20	99	6.837 L	11:24	17:57	22:48	28:30	34:11	39:53	45:35	51:17	57:00	62:42
27	12:45	88	8.653 L	14:25	21:38	28:51	36:04	43:16	50:30	57:42	64:54	72:07	79:19
30	14:10	80	10.683 L	17:48	26:43	35:37	44:31	53:25	62:19	71:13	80:07	89:01	97:55
33	15:35	72	12.926 L	21:33	32:19	43:56	53:52	64:38	75:24	86:10	96:57	107:43	118:30
36	17:00	66	15.384 L	25:39	38:28	51:17	64:06	76:55	89:44	102:34	115:23	128:12	141:01

END OF SECTION 31 30 00

**SECTION 33 47 23
SEWERAGE LAGOONS**

PART 1- GENERAL

1.1 SECTION INCLUDES

- A. Construction of wastewater treatment lagoons
- B. Drawings and General Provisions of Contract, including General and Special Conditions, apply to this section.

1.2 DEFINITIONS:

- A. Berms: Pond embankments
- B. Backslopes: Outside slopes of berms
- C. Suitable Fill Material: Sound earth, free of cinders, ashes, refuse, sod, rocks, boulders, pavement, and organic materials
- D. Grading Limits: 10' outside all cut/fill sections
- E. Maximum Density, Optimum Moisture: Per curve developed using Standard Proctor method
- F. Pond Piping: Gravity wastewater piping

1.3 RELATED SECTIONS

- A. Section 01 33 00 – Submittals
- B. Section 31 25 00 – Erosion Control
- C. Section 31 37 13 – Rock Liner
- D. Section 33 30 00 – Sanitary Sewerage

1.4 SUBMITTALS

- A. Submittal shall conform to Section 01 33 00.
- B. Control Structure Drawings: Submit fabricator's shop drawings and obtain approval before shipping.
- C. Valves: Submit shop drawings, Product Data, or Certification. Obtain approval before shipping.
- D. Piping Submit manufacturer's certification of quality prior to delivery of pipe.

1.5 JOB CONDITIONS

- A. Testing Sequence:
 - 1. Notify Owner's Representative of readiness to begin test at least 72 hours before test will start.
 - 2. Test to be commenced in the presence of the Owner's Representative.
- B. System Activation:
 - 1. The Contractor shall not operate valves or structures to allow domestic waste flow into new construction.

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1.6 METHOD OF MEASUREMENT AND BASIS OF PAYMENT:

- A. Earthwork: Earthwork includes all excavation, dewatering, and sludge removal for construction of the Primary Cell. Payment shall be made based on percentage of completion.
- B. Clay Liner: Clay liner is included in earthwork cost.
- C. Rock Lining: Payment shall be made based on percentage of completion.
- D. Control Structures: Each control structure will be paid for as a single complete unit when called out as a specific bid item. In line control structures not called out as specific bid items shall be included in the bid item for Site Piping and Valves. Payment shall be made based on percentage of completion.
- E. Intake Structure modifications: The intake structure modification will be paid for under the lump sum bid for Intake Structure Modifications.
- F. Discharge Structure modifications: The discharge structure modifications will be paid for under the lump sum bid item for Outfall Piping Modifications.
- G. Pond Piping: Pond piping not part of the aeration systems or control structures shall be paid as a lump sum under Site Piping and Valves.
- H. Site Piping and Valves will be paid under the lump sum bid item, based on percentage of completion.
- I. Gravel Roads: Road repairs, whether classified as access or service roadways, will be paid for per the Bid Form.
- J. Site Restoration: This item includes seeding and mulching and will be paid for as a lump sum item.
- K. Rock Excavation: Rock excavation is incidental to excavation. Borings were not taken for design.
- L. Testing and process startup assistance: Testing and startup assistance is not a pay item. The Contractor shall include all testing and startup assistance costs in the pay items listed previously.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Clay Liner:
 - 1. On Site: On site clay liner material meeting permeability requirements may be re-used.
 - 2. Off Site: If the Contractor intends to use an off site source for clay liner material, he shall submit permeability test results on material from that source prior to its use.

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3. Material for liners shall not have a coefficient of permeability exceeding 1.35×10^{-7} cm/sec, unless added thickness of liner is provided in accordance with the following equation:

$$T = \frac{H \times K}{5.4 \times 10^{-7}}$$

T = Total Liner Thickness, Feet

Where: H = Head of Water in Lagoon, Feet

K = Coefficient of Permeability of Liner Material cm/sec

Such liner thickness is considered a minimum. The Contractor may provide added thickness as he deems necessary to assure compliance with testing requirements.

- B. Berms: Suitable fill material
- C. Pond Piping: Ductile iron, ANSI A21.50 or ANSI A21.51, Pressure Class 350.
- D. Joints:
 - 1. Mechanical: ANSI A21.11.
 - 2. Push On: ANSI A21.11.
- E. Concrete Structures:
 - 1. Precast: 48" ID manhole sections, ASTM C478 or ASTM C76, Class III. Mastic joints or O-ring joints conforming to ASTM C361 or C443 may be used as desired, provided the exterior of the joint is coated with coal tar epoxy and fully grouted after assembly. Pipe gaskets shall be A-LOK or approved equal.
- F. Control Structure Castings:
 - 1. Neenah R-1764, two hole cover or approved equal, unless otherwise specified on plans.
- G. Valves: Gate valves, AWWA C509 (3" to 12") or AWWA C500 (14" to 48"), non rising stem, mechanical joint ends, cast iron wedge with resilient rubber facing, clockwise closure.
- H. Valve Boxes: Three (3) section cast iron.
- I. Turtle Screens on Intake Lines and Outlets: Fabricate from ASTM A615, Grade 60, deformed bars as shown on the Drawings.
- J. Roadways:
 - 1. Access Roads: per plan detail.
- K. Seed and Mulch (this applies to all disturbed areas).
 - 1. Seed: 30 percent perennial rye, 30 percent fescue, 20 percent Kentucky bluegrass, and 20 percent red top.
 - 2. Mulch: Straw, marsh hay, or wood excelsior.

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PART 3 - EXECUTION

3.1 PREPARATION

- A. Clearing and Grubbing not anticipated for this site.
- B. Topsoil Stripping: Within disturbed area, stockpile on site for reapplication to all areas except inner slopes, lagoon bottoms, and roadway areas.
- C. Erosion Control: Provide erosion control barriers and ditch checks where runoff will be directed away from the existing cells. Erosion control devices shall be in place prior to Clearing or Stripping.

3.2 INSTALLATION

- A. Berms and Levees:
 - 1. Vegetation and other unsuitable materials shall be removed from the area where the embankment is to be placed.
 - 2. Place in 8" layers compacted to 95 percent maximum density.
 - 3. Finished Grade Tolerance:
 - a. Berms and Levees: At or above plan elevation.
 - b. Pond Slopes and Bottoms: Within 3" of plan elevation.
- B. Control, Outlet, and Metering Structures:
 - 1. Backfill: Suitable fill material compacted to 95 percent maximum density.
 - 2. Pipe Openings: Fill around lower half of pipe with non-shrink grout. Leave pipe gasket free to flex.
- C. Clay Liner:
 - 1. Liner shall be continuous and unbroken.
 - 2. Minimum thickness of 2-feet, however, it is the responsibility of the Contractor to verify the permeability of the soil he intends to use as a seal.
 - 3. The Contractor is responsible to verify the seal thickness will meet the testing provisions and requirements of the Missouri Department of Natural Resources Regulations (10 CSR 20-8.200 (6)(c).
- D. Surface Restoration:
 - 1. Topsoil: Minimum 4", lightly compacted and rolled on all surfaces to receive seed and mulch or sod.
 - 2. Fertilize at 200 pounds per acre with 12-12-12 fertilizer.
 - 3. Seed shall be applied at a rate of 100 lb./acre.
 - 4. Ditches over 3 percent: sod or place erosion control netting.
 - 5. Mulch at the rate of 1,200 lb./acre.

3.3 POND PIPING TESTING

- A. Test piping runs from each control structure to the next downstream lagoon or structure in accordance with Section 33 30 00.

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B. Valved Inlet Lines: No test required.

3.4 LAGOON TESTING – not applicable

END OF SECTION 33 47 23

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