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SMALL WASTEWATER TREATMENT PLANTS

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16.1 PURPOSE

This chapter:

a. Identifies the planning and design approach to be used for small wastewater treatment plants(WWTP) with maximum capacities of 500,000 gallons per day. This guide pertains to new plants and expansion of existing plants.

b. Defines specific criteria by which small WWTPs will be designed.

c. Delineates submittal requirements to MSD for review and approval of small WWTPs.

d. Delineates requirements for opinions of construction and operating costs.

16.2 SUBMITTAL REQUIREMENTS

The Design Engineer shall submit to MSD for review and approval, the Concept Plan, Preliminary Design and Final Design. Approval by MSD will be required prior to authorization of any succeeding design phase.

The Design Engineer shall submit to the Jefferson County Health Department and Kentucky Department of Housing for review and approval of the Final Design. The submittal shall include the standard single submission form. Approval by these agencies will be required prior to authorization of any construction.

Submittals shall be prepared in report format (8.5-inch x 11-inch) and shall be spiral bound, three-ring bound or bound, in some other permanent manner. Appended to or included in the bound submittal shall be maps, figures, and drawings as necessary. Sections are to be organized and tabbed according to the requirements of this section.

16.2.1 Concept Plan Submittal

The purpose of a Concept Plan is to provide MSD with preliminary design data for the proposed facility to determine the compatibility of the proposed facility with approved Watershed 201 Facility Plans and MSD's Area Action Plans, and to justify construction and operation of the proposed facility.

Concept Plans relating to small WWTPs shall include the following elements:

a. A narrative description of the proposed service and drainage areas that can be served with the proposed facility. Include a description of existing developments that can be served by the proposed facility or facility expansion.

b. A description and reference to any Action Plan requirements that relate to the proposed service area (on-site area to which service will be initially provided) and drainage areas (off-site areas that can be served in the future with the proposed facility).

c. The designated land use for the proposed service area and drainage areas.

d. Population and flow projections for the proposed service area and drainage areas.

1. Existing Facilities - If the project involves an existing facility, provide metered plant flow data. The metering period must meet the following requirements:

a) Measured after current service area was connected to the treatment facility. If additional connections have been added since the most recent flow measurement, the flow must be remeasured.
b) Consist of at least seven consecutive days; actual requirement will be site-specific and as approved by MSD.
c) Include enough flow data during and after rainfall events to show the severity of infiltration/inflow (minimum of 1 inch of rain at the treatment plant during 24 hours); provide the rainfall data during metering period and the previous week.

Provide certification as to the amount of rainfall during each 24-hour period. Certification shall include a rain amounts at the site and rainfall information from a local weather service such as the airport.

Some flow data may be available from existing MSD flow meters. Also, account for reserve capacity at the plant.

2. Contribution from New Development - Define the buildings:

a) Residential - Note number of single or multi-family units. If multi-family, break down by number of one, two, and three bedrooms.

b) Commercial - Note the square-footage of floor space and expected tenants or type of use along with an estimate of the amount of wastewater that will be generated.

c) Industrial - Note the nature of the processes employed and of the wastewater generated.

If the proposed commercial or industrial client has an existing comparable location served by the Louisville Water Company, provide that address. If not, provide records on the previous 12 months of water consumption (or wastewater discharge, if significantly different than water consumption).

3. Expected Influent Quantity and Quality - For new facilities provide estimated:

$CBOD_5$ (milligrams per liter (mg/L))
TSS (mg/L)
NH_3-N (mg/L)
Average Daily Flow Rate (GPD)
Peak Daily Flow Rate (GPD)
Peak Hourly Flow Rate (GPD)

Note: For facilities that will treat wastewater from industrial facilities, consult MSD for additional requirements.

e. A description of alternative means of sanitary sewer service considered.

f. A recommended plan, including timetable, for the provision of sanitary sewer service to the area including connection of developed or undeveloped areas. The recommended plan should include preliminary drawings to illustrate proposed collection and treatment facilities.

For the treatment facility, a site plan should be included to show, on not less than a 1"=200 scale, contours, the 100-year floodplain, the proposed facility location, the land set aside for future expansions, adjacent properties, and the proximity of existing or proposed homes.

A minimum 200-foot buffer is required between the property line and any existing, proposed, and future treatment facility buildings and basins. On new developments, buffer requirements shall be included on the recorded plat.

For components of the facility within the floodplain and floodway, approval letters from the Kentucky Division of Water, Floodplain Management Section, or in some instances, the U.S. Army Corps of Engineers will be required. A copy of the approval letters should be submitted as early as is possible in the planning phase but no later than submission with the Concept Plan. The final design must allow 1 foot of freeboard between the 100-year flood level, road access to the equipment buildings and pedestrian access to the entire WWTP.

g. A description of how and when the small WWTP will be eliminated if the WWTP is proposed as temporary.

   If the proposed WWTP will be an expansion of an existing WWTP, provide information on the condition of existing facilities and proposed plans for integrating the WWTPs during construction, start-up, and routine operation.

h. A schematic flow and process diagram of the proposed facility including general process description(s), design criteria and sources, assumptions, and preliminary calculations.

   Historically, wastewater treatment facilities in Jefferson County have been rectangular or circular package extended aeration plants. The oxidation ditch process is an acceptable process alternative.

i. Justification for the proposed small WWTP (as per Section 16.3.4).

16.2.2 Preliminary Design and Final Design Submittals

Preliminary Design and Final Design submittals relating to small WWTPs shall include the following elements:

a. Design Documentation - Preliminary and Final Design submittal shall include all design requirements, assumptions, background data, design calculations, and references. Submittals shall include, but not be limited to, those elements outlined in Section 16.4.1.

b. Plans - Original drawing material must be double-matte, (3 mil- thickness) 24-inch x 36-inch sheet size mylar. Review transmittal copies may be standard blue-line prints. Provide a Location Map and Sheet Index on the Title Sheet. Show the project name, sheet title, submittal date, and the appropriate Professional Engineer and/or Land Surveyor seals and signatures on all sheets. Plans must be legible and uncluttered, and

consistent with the MSD Standard Drawings Manual. Submit six copies of initial submissions and six copies of resubmissions.

c. Specifications - Prepare specifications consistent with the MSD Contract Documents Manual.

16.3 DESIGN APPROACH

16.3.1 Compliance With Area Sanitary Plans

Proposed construction or expansion of small WWTPs shall be in compliance with the approved Wastewater 201 Plan and MSD's Area Action Plans.

16.3.2 Approvals

The final design of a small WWTP, whether it will be privately-owned or MSD-owned, requires the approval of the following agencies:

- MSD
- Kentucky Division of Water
- Jefferson County Health Department

All submittals must be signed and sealed by a Professional Engineer licensed in the Commonwealth of Kentucky.

Note: In addition to approvals of the above agencies, the owner/builder/developer of an existing or proposed small WWTPs must obtain all other permits required, including a conditional use permit from the Jefferson County Division of Planning and Development Services and a building permit from the Jefferson County Code Enforcement Division office prior to expansion or construction of a small WWTP in Jefferson County.

16.3.2.1 MSD-Owned Facility

A Lateral Extension Agreement between a developer and MSD must be executed for any facility to be dedicated to MSD for ownership and perpetual maintenance.

The LE Agreement is valid for one year from the date of its execution; however, an extension may be granted as long as no significant changes are made. Construction must begin within one year of the execution of the LE Agreement or within one year from the extension, if granted.

No connection to the wastewater system may be made until all provisions of the LE Agreement are satisfied. The installation must be warranted and the appropriate bonds (performance, payment, indemnity, etc.) must be posted.

Developers desiring to expand or construct a treatment facility shall be responsible for all design and construction related costs unless MSD participation is approved by the Board.

16.3.2.2 Privately-Owned Facility

If the project is the expansion or construction of a facility that will be privately-owned and operated, a letter from the owner agreeing to the Concept Plan as defined in Section 16.2.1 is required.

16.3.2.3 Permits

For all projects, MSD will handle submission of permit modification-related items to DOW. The developer's engineer must prepare and submit all permit information and design documents to MSD, who will review and forward (when approved) to the other review agencies holding jurisdiction.

Permit submittals shall include:

a. Kentucky Pollutant Discharge Elimination System Permit application forms.

b. WWTP and sewer line application form and fee.

c. Easement, if WWTP discharge is not on blueline stream.

d. Evidence of availability for laboratory services.

16.3.2.4 Waste Load Allocation(WLA)

The Waste Load Allocation defines limits on the maximum amount of pollutants the proposed plant may add to the receiving stream. DOW determines the WLA. Following review and approval of the Concept Plan by MSD as defined in Section 16.2, MSD will request the WLA from DOW.

Filtration is required for all small WWTPs provided under the requirements of this Chapter. Design Engineers must recognize and

account for filter backwashing in the planning and design of proposed facilities.

If the proposed plant is to be an expansion of an existing facility, the new WLA may be more strict than the existing KPDES permit, and will apply to the entire facility, new and old. Therefore, the expansion project must incorporate the existing facility's design and correct any deficiencies. For example, if the new WLA requires post-aeration, the piping and blower capacity must be designed to aerate the total effluent flow.

16.3.3 Service Level

Guidelines provided in the Design Manual govern the planning and design of small WWTPs with a design capacity of 500,000 gallons per day or less. Proposed construction or expansion of small WWTPs greater than the stated range will be considered by MSD on an individual basis.

16.3.4 Justification

It is MSD's policy to reduce the number of small WWTPs and onsite treatment systems in the service area whenever practical. In accordance with this, the need for a small WWTP must at a minimum, be justified according to whether or not MSD's planned interceptor sewers are not in place necessitating the construction of a temporary WWTP. Cost justifications must be presented comparing the estimated capital and operating cost of the proposed small WWTP to the cost of constructing a gravity sewer or pump station and forcemain to the nearest appropriate point of connection to the existing MSD system. Based on this cost evaluation, MSD may, as its sole option, choose to accelerate service extensions to the property to eliminate the need for the small WWTP. Cost sharing ageements for the costs to extend service on an accelerated basis will be mutually agreed to by the Developer and MSD. Developer participation in the costs to extend service will not exceed the lesser of the cost for MSD to extend service or the estimated cost to construct the small WWTP.

16.3.5 Variances

Variances to the requirements of Sections 16.2.1 through 16.3.4 will be considered by MSD. Variance requests must be in writing and provide both technical and economic justification for the variance from the established standards. Alternatives to that required in the Manual must be shown to be:

a. Technically sound.

b. In compliance with water quality and construction regulations of MSD, DOW and the Jefferson County Health Department.

c. In compliance with approved Wastewater 201 Facilities Plans and MSD Area Action Plans.

d. Economically justified.

16.4 DESIGN CRITERIA

16.4.1 General

Design requirements, assumptions, background data, design calculations and references must be documented. Required calculations and, where appropriate, equipment manufacturer's technical literature should include, but not be limited to, the following items:

a. Anchoring, buoyancy, and cathodic protection

b. Corrosion and freeze protection

c. Drainage, erosion prevention, and control measures

d. Earthwork

e. Elevations, including benchmarks

f. Equipment (motors, blowers, pumps, etc.) sizing

g. Instrumentation

h. Loading rates, detention times, and capacities at average daily, peak daily, and peak hourly flows

i. Pipe, valve types, and sizes

j. Structural engineering (concrete, reinforcement, etc.)

k. Tank volumes

l. Utilities (electrical system, plumbing, etc.)

A detailed interim operational plan for temporarily conveying and treating influent should be provided if existing facilities are being expanded and the expansion would interrupt the treatment operation. During construction, the level of treatment provided shall be such that the facility remains in compliance with the KPDES permit limits. Final approval of plans and specifications will be contingent upon approval of an interim operational plan.

The facility's conformance with KPDES discharge limits must be guaranteed by the developer for one year from the acceptance date by MSD and the Jefferson County Health Department. Any modifications required to bring a WWTP into compliance during the first year of operation will be at the developer's expense. If modifications are required, MSD will meet with the developer to discuss the required modifications. MSD reserves the right to make the modifications and bill the developer if the developer is unresponsive.

Specifications should be developed in a manner consistent with the MSD Contract Documents Manual and "Recommended Standards for Wastewater Facilities" (Ten State Standards).

16.4.2 Process

The design criteria for small WWTPs shall be according to "Recommended Standards for Wastewater Facilities" (Ten States Standards), edition as directed by DOW.

16.4.2.1 Influent Pumping

If the influent will not flow into the treatment facility by gravity, an on-site lift station shall be installed, complying with MSD pump station design standards.

a. Peak Flow - The peak pumping flow shall be as defined in the Concept Plan with the following site-specific definitions:
   1) New facility shall be at least five times the WWTPs average daily design flow.
   2) Expanded WWTP, which is the sum of the current actual wet-weather peak hourly flow plus at least five times the new average daily design flow.

b. Emergency Storage - Minimum emergency storage volume is two hours of average daily design flow. In addition to the wetwell, the volume of the influent sewers may be counted toward the required volume, up to the elevation at which

stored flow could back up into a basement/building or overflow to the environment. The assumption should be made that basement service to houses on the lowest lots will be provided, unless deed restrictions so preclude.

c. Back-up Power - An on-site internal combustion engine-powered generator and an automatic transfer switch or dual independent electric feeder lines must be provided to serve at least the pump station loads, unless a waiver is granted under the electrical provisions of this Chapter. A critical silencer must be provided to minimize noise from the engine-powered generator.

d. Overflow Alarms - Wetwells must have audible, visual and telemetered high level alarms.

e. Discharge Piping - Discharge piping shall be designed to allow for diversion from unit to unit when multiple units are provided.

16.4.2.2 Comminutors

Comminutors are not required on facilities treating less than 0.4 million gallons per day. If a facility will treat 0.4 MGD or more, a comminutor will be required. It must be sized for peak hourly flow and placed in an accessible location other than in the wetwell. Acceptable models are a Muffin Monster or Worthington reciprocating model. Drum-type comminutors are not approved. Slide gates should be used to direct flow to the comminutor.

The channel leading to the comminutor must be designed to both compensate for head losses without surcharging the influent pipe and prevent overflows should a power failure occur. A lock-out disconnect switch must be located within view of the comminutor but above any potential flooding.

16.4.2.3 Bar Screens

An easily-accessed, manually-cleaned bar screen must be provided to allow for temporary comminutor bypassing. The screen must be inclined (30 to 45 degrees) and the bars must be 1/4-inch thick stainless steel or aluminum, spaced 1½ inches on center. The approach velocity must be at least 2 feet per second.

16.4.2.4 Preliminary Treatment

Grit removal is required for facilities lacking multiple parallel aeration, clarification, filtration, and disinfection units. Grit removal shall consist of a depressed area in the influent channel designed for flow velocities of 1 to 1½ ft/s with operator access for manual grit removal or a separate basin with mechanical grit removal. The depressed area shall have a minimum volume of 1 ft^3 per 100,000 gallons of WWTP average daily design capacity. Dual facilities shall be provided. A means of isolating and draining each section shall be provided for cleaning and service.

16.4.2.5 Flow Equalization

Flow equalization may be required for existing facilities that are to be expanded. If peak daily flow during a 1-inch, 24-hour rain event is greater than 150 % of the average daily flow, the developer's engineer or Design Engineer must contact MSD to determine if flow equalization is required. Flow equalization, when required, should be designed so that it limits the peak flow to the treatment plant to the peak design capacity and must be designed in accordance with "Ten States Standards."

16.4.2.6 Aeration

Extended Aeration - Mechanical aeration is not allowed except in oxidation ditches.

a. Demand and Supply - Determine the aeration requirements (by function and in total) and the aeration supply in standard ft^3/min. At least two blower/motor units are required; the firm capacity must meet peak week demand. Firm capacity is defined as the capacity available with the largest unit out of service.

b. Capacity - Minimum firm aeration capacity shall be 2,050 ft^3/lb of BOD applied.

c. Piping - Specify the type and dimensions of all aeration piping and fittings and the make and model of all equipment. Size air piping and diffuser systems consistent with "Ten States Standard." Total head loss from the blower (or silencer) outlet to the diffuser inlet must not exceed 0.5 psi at average operating conditions.

d. Tankage - The only used equipment which may be approved (on a case-by-case basis) will be steel aeration and clarifier tanks which have been sand-blasted to bare metal and recoated. No used equipment will be allowed if the expected lifetime of the facility is 10 or more years. Approval for the use of used tankage will be given only after a satisfactory and thorough inspection by MSD. In-ground reinforced concrete tanks will be required otherwise.

e. Blowers/Motors - Provide the proposed ratings for Roots URAI or AF series rotary or Spencer, Hoffman or Lampson turbine blowers. Rotary blower operating speed shall not exceed 1,750 rpm; turbine blower operating speed shall not exceed 3,600 rpm. Provide mounting pad or pedestal and vibration dampening design and materials. Provide intake filters as per manufacturer's recommended specifications. Silencers must be provided to abate noise levels to no more than 65 dB (on the "A" scale) from any point within 100 feet of the facility. Provide universal silencers.

f. Check and Gate Valves - Provide a "TRW Duo-Chek II" check valve or equal and a brass, resiliently-seated, rising stem gate valve on each discharge pipe. Gate valves under 6 inches in diameter must be threaded; larger gate valves may be flanged.

g. Headers - The minimum overhead clearance shall be 7 feet. Headers must have gate valve shut-offs.

h. Drops - Provide spacing dimensions. Drops must be designed with horizontal unions and stopcock valves to allow independent drop removal for inspection and maintenance. Locate unions and valves within 1-foot of the walkway or vice versa.

i. Diffuser Bars - Specify bar height from tank floor and diffuser spacing. The minimum acceptable height from the tank floor is 1 foot.

j. Diffuser Caps - Use coarse-bubble, disc-type diffuser caps, or stainless steel "Sanitaire" type coarse bubbler diffusers

unless special permission for fine-bubble caps is granted. Provide make, model, and capacity.

Oxidation Ditches - Brush aerators, vertical aerators, and disc aerators will be considered for mechanical aeration systems for oxidation ditches.

a. Demand and Supply - Determine the peak week oxygen requirements and mixing requirements for the oxidation ditch. Provide a mechanical aeration system that will meet these requirements. Certified testing will be required to verify mechanical aerator performance in terms of power performance. The oxygen requirements will be based on a transfer rate of 2 pounds per horsepower per hour in clean water under standard conditions unless site specific design information is available. Design transfer efficiencies will be included in the specifications.

b. Design Requirements - Mechanical aeration system will be consistent with "Ten States Standards" and the requirements of this Chapter, including:

1. Design average dissolved oxygen concentration of at least 2 mg/L under peak week loading conditions.
2. Design average velocity of 1 foot per second, in any cross-section of the basin, to maintain biological solids in suspension.
3. Firm capacity with the, largest unit out of service, must meet oxygen demand.

c. Tankage - In-ground reinforced concrete tanks will be required for oxidation ditches.

Baffles and inlet/outlet ports must be designed to prevent short-circuiting. The minimum freeboard allowed is 18 inches. If the treatment capacity is 50,000 GPD or greater, the tanks must have valved drain lines piped to the influent pump station or have sumps so that tanks can be easily dewatered with a portable pump.

d. Mechanical Aeration Systems - The following general features will be provided for each mechanical aeration system:

1. Mechanical aeration equipment will be designed to operate on a continuous basis.
2. Rotors for the brush and disc aerators will be the same width as the oxidation ditch channel.
3. At least one of the following means will be provided for routine adjustment of the oxygen/mixing input to the mixed liquor:

    a) Vary the submergence of the mechanical aerator(s) and/or
    b) Vary the rotational speed of the aerator(s).

e. Covers and Maintainability - Mechanical aeration systems will be easily accessible for corrective and preventive maintenance. Motors, gear housings, bearings, grease fitting, etc., will be easily accessible and protected from inundation and spray. Fiberglass covers will be provided in the area of the aerators to minimize spray. Aerators will be protected from freezing due to splashing.

16.4.2.7 Clarification

Design for peak hourly flow at a maximum surface overflow rate of 1,000 gallons per day per square foot. Provide the surface loading rate, surface overflow rate and weir overflow loading rate at average daily, peak daily, and peak hourly flows and loadings.

a. Skimmers and Sludge Returns - Polyvinyl chloride pipe is the preferred pipe material. The diameter of the skimmer pipe must be at least 3 inches; the sludge return, 4 inches. Both must have resiliently-seated gate valves for flow regulation and easily-accessed clean-outs with PVC plugs. The sludge return must be designed to return up to 150 % of the average daily design influent rate. Skimmers must be adjustable without the operator having to put his or her hands into the wastewater.

b. Weirs and Baffles - Weirs and baffles shall be aluminum or fiberglass reinforced plastic and shall be adjustable. Edges may be straight or V-notched. Show location and dimensions of all internal tank baffling.

c. Maintenance - A skimmer within the stilling area must be provided far from the influent port to facilitate daily scum removal. Grating over the clarifier must not hamper daily hosing of surface scum. Access shall be provided for scraping the hopper sides to prevent channeling.

d. Return Activated Sludge Chlorination - The RAS line must be fitted with a chlorine solution system for control of filamentous bacteria. The system must include the following components: (1) freeze-protected 1-inch diameter piping from the disinfection chlorine system or a separate liquid bleach system, (2) regulating valve, (3) port located to maximize in-line mixing before discharge to the head of the plant, (4) back-flow preventer, and (5) a drain-down valve to prevent in-line freezing during cold weather.

e. Polymer - A system for mixing, conveying and applying polymer is required for controlling bulking incidents. It must include the following components:
   (1) plastic solution storage tank sized for peak flow,
   (2) positive displacement pump with an adjustable feed rate,
   (3) non-vortexing mixer,
   (4) freeze- protected, ½ to ¾-inch diameter conveyance piping to the middle of the influent port,
   (5) back-flow preventer, and
   (6) flushing port threaded for a garden hose and located at or near the polymer feed system.

16.4.2.8 Tertiary Treatment

Dual, rapid sand, or mixed media filters are required at all new or expanded installations. Tertiary filters shall be designed to operate at a maximum rate of 5 gallons per minute per square foot at peak week loading. Filter capacity must be sized for firm capacity, i.e., with the largest filter out of service. Flows in excess of peak week rates shall bypass the filters through a passive overflow system and be routed directly to the disinfection system. No components of the system may be pneumatically activated. The backwash system must be piped to the head of the plant. The plant dseign capacity must include backwashing. Piping shall be arranged with appropriate valves to bypass tertiary treatment for routine maintenance.

16.4.2.9 Disinfection

Design disinfection systems for daily average and peak hourly flow rate. Ultraviolet or chlorine disinfection is preferred for all WWTPs. Tablet chlorination is not allowed.

a. Ultraviolet Disinfection - Use Trojan horizontal units. An auxiliary bank must be installed to provide complete disinfection when one unit is out of service for maintenance.

b. Chlorination and Dechlorination Systems - KPDES permits require 50,000 GPD or larger facilities which disinfect with chlorine to dechlorinate. Sulfur dioxide shall be used for dechlorination. Because both gases are dangerously reactive, two independently-housed systems must be designed according to current Chlorine Institute Standards. The chlorine room must be maintained above 40°F; the sulfur dioxide room must be maintained above 65°F. Temperatures must be maintained via resistance heaters and thorough weather-stripping and insulation. All related equipment must be corrosion-resistant.

   Chlorinators and sulfonators shall be Wallace and Tiernan Model V-100 wall-mounted units or equal. Chlorinators and sulfonators shall be capable of accepting a signal from the flow meter for flow proportional feed. Scales for 150 pound cylinders and leak detectors for chlorine and sulfur dioxide shall be installed.

c. Liquid Sodium Hypochlorite Systems - These systems may be outdoors if they are properly protected from cold weather. Provide the following appropriately sized components: (1) a fiberglass tank with a sliding lid for solution mixing, (2) a plastic container for chemical storage, with a minimum storage volume suitable for 2 weeks storage of chemical under maximum month loading conditions, (3) a Chem-Tech feed pump and compatible motor, (4) a weatherproof covered receptacle, (5) 1/2-inch diameter flexible PVC suction tubing, and (6) 1/2-inch diameter polyethylene discharge tubing with heat tape.

d. Room Isolation - Gaseous or liquid chlorination and dechlorination systems must be in separate rooms, with

entry doors only to the outdoors. The walls and ceiling must be painted with one coat of commercial-grade primer and two coats of commercial-grade epoxy after all joints have been caulked to prevent leakage in the event of a gas leak. Doors must be corrosion-resistant.

e. Chlorine Contact Tank - The tank must be designed to provide at least 15 minutes of detention time for peak hourly flow or a minimum of 30 minutes detention time for average daily design flow, whichever requires the larger tank size. Baffling should be provided to prevent short circuiting.

f. Backflow Prevention - A vault-type backflow preventer must be installed to protect the potable water supply or a backflow preventer may be installed inside the equipment building as long as it and all exposed lines are protected from freezing and a drain is provided for testing.

16.4.2.10 Flow Metering

a. Weirs - If the primary flow measuring device is a V-notch weir, it must have at least 6 inches of free fall. The weir plate must be made from aluminum or stainless steel, and have an inverted isosceles 60° or 90° triangular cut with a beveled edge. It must be sized to accommodate ten times the average daily design capacity. Show the weir design on the plans. The latest DOW regulations should be consulted for additional requirements. Weirs must be installed so that leakage around the weir is minimized.

b. Meter - Any facility with a design capacity of 50,000 GPD or more must have a recording Stevens Model 61R flow meter. Ultrasonic meters are not acceptable. The meter and its stilling well must be located in an appropriate location depending on the facility, such as, the most quiescent place in the contact tank or a special tank and/or primary device. Avoid the turbulence of the post-aeration system. The meter must be housed in a weatherproof enclosure.

16.4.2.11 Post Aeration

All facilities must have post-aeration to maintain an effluent dissolved oxygen minimum of 7 mg/L. For diffused air, the

minimum aeration requirement is 0.154 ft^3/min. per 1,000 GPD of design capacity based on average daily design capacity. Piping must be designed as in Section 16.4.2.6. If diffused air is selected for post aeration, the diffuser bar must be near the floor of the contact tank and downstream from chlorination/dechlorination inputs. Use flexible sheath type fine bubble diffuser. If cascade aeration is selected, a minimum of 19 feet of vertical drop is required.

16.4.2.12 Biosolids Holding Tank

a. Aerobic Biosolids Holding - An aerobic biosolids holding tank must be provided, having a volume approximately equivalent to 15 % of the average daily design flow capacity. Blower capacity allotted to the biosolids holding tank must be at least 30 ft^3/min. per 1,000 cubic feet of tank volume. Air drops and diffusers must be designed, as defined in Section 16.4.2.6, to maintain at least 1 mg/L dissolved oxygen in 100° Fahrenheit ambient conditions. The ability to supernate the biosolids holding tank should be incorporated. The tank shall be covered and vented through appropriate odor control facilities, designed in accordance with Chapter 17 of this Manual.

b. Biosolids Decanting - A biosolids holding tank decant system must be provided with two lines, one for decant and one for sludge loading. The biosolids holding tank decant pipe must be through the wall and have a rigid, adjustable handle for raising and lowering for scum skimming.

c. Biosolids Withdrawal - Biosolids removal must be through a 4-inch diameter line with a 4-inch diameter gate valve and male quick-coupling connection. The 4-inch diameter line in the tank should extend to the base of the holding tank. A short length of sturdy chain must be secured to the exterior tank wall beside that gate valve so the valve can be padlocked in a closed position to reduce vandalism.

16.4.3 Site Features

16.4.3.1 Access Roads and Walkways

Access road pavement must be at least 12 feet wide and capable of bearing a 50,000-pound gross vehicle weight tandem-axle tank

truck. The maximum grade allowed is 7 percent, however, site specific conditions may allow grades greater than 7 percent; the turning radii must be at least 50 feet. The road must be paved with bituminous concrete as per MSD standard pavement design. Walkways must be 4 inches thick and be constructed of plain or reinforced concrete. Access roads and walkways must be designed to 2 feet above 100-year flood elevation.

16.4.3.2 Fencing

Commercial-grade, hot-dipped galvanized security fencing must consist of 6-foot high, chain link fabric, topped with three strands of barbed wire encircling the entire facility and a pair of 6-foot wide gates without a center post. Depending on the locations of the vehicle gate and the outfall, an additional 3-foot wide walk-through gate may be required to facilitate inspection and sampling at the outfall.

Gaps between fencing, posts, and gates must not exceed 2 inches. The fabric must be 9-gauge, 2-inch mesh; the barbed wire, 12.5 gauge; and the tension wires, 7-gauge. Twisted selvage must be provided on top and bottom. Top rails are required and must be 1 5/8-inch pipe.

The gate frame must be 2-inch diameter pipe. Line posts must be 2.5-inch diameter pipe; end and corner posts, 3-inch diameter pipe and gate posts, 4-inch. Line posts must be no more than 10 feet apart.

The barbed wire should be mounted on 45-degree arms and capable of supporting 250 pounds anywhere along the outer strand.

16.4.3.3 Site Drainage

Show grading plans. Direct run-off away from buildings, tanks and walkways.

16.4.3.4 Landscaping

Show landscaping plan. Include both the common and scientific names for all trees and shrubs. Enough of the trees must be indigenous evergreens to provide sufficient visual and noise screening during the winter.

16.4.4 Building Features

16.4.4.1 Equipment Buildings

a. General - Buildings must be designed to comply with the appropriate building code. They must be safe to work around, easy to maintain, and resistant to theft and vandalism. Chemical deliverers must be capable of getting full 150-pound cylinders into the building without undue effort. Interior layout minimums require 3-foot aisles and 7-foot overhead clearances. Entry to the building and any rest room facilities shall be accessible to the handicapped.

b. Block Buildings - Construct buildings using Type N-1 hollow, load-bearing concrete blocks meeting ASTM C-90 requirements and Type S mortar meeting ASTM C-270 requirements. For areas that require temperature control, fill block with sprayed foam insulation. Depending on the wall height, floor space, and roof support design, bond beaming and/or vertical in-cell reinforcement may be required. Wooden roof framing must be protected by fire-retardant ceilings of 5/8-inch thick drywall. To minimize painted surfaces, spilt-faced exterior block (natural or colored) may be considered on a case-by-case basis.

c. Siding - Non-masonry siding soffits and facia boards must be vinyl rather than aluminum.

d. Insulation - Insulate ceiling with fiberglass batts (R-40, minimum). Provide vapor barrier.

e. Paints and Coatings - Exterior painted surfaces, which should be kept to a minimum, must be painted with commercial-grade Porter's Umber Brown or equal. Interior surfaces must be painted a light color to maximize visibility. For temporary facilities, exterior metal surfaces other than factory-enameled, galvanized, stainless steel, and aluminum items must be painted with two 8-mil coats of Porter's 7001 coal tar epoxy or equal; proper curing time between coats is required.

f. Doors - Commercial-grade garage and walk-through doors must be solid without windows, with the following exception: if serving a chlorine or sulfur dioxide room,

doors must have a window with a cover and hasp. Doors should have a minimum 36-inch opening. Doors to chlorine and sulfur dioxide rooms must be insulated wood or fiberglass-reinforced plastic. Other doors may be steel, but may not be aluminum. Hardware must be stainless steel and should include passage lockset and a hasp for a padlock, rather than an entry lockset with key.

g. Roofing - The roof pitch should be 4:12. An aluminum drip edge should be provided. Shingles must be 240-pound commercial grade, fiberglass, dark brown, and underlain with 15-pound felt paper.

h. Guttering - Buildings must have continuous aluminum gutters and downspouts. Gutters shall have a baked enamel finish. Provide splashblocks. Run-off must be directed to avoid erosion and away from buildings, tanks, and walkways.

i. Toilet Room Accessories - Provide grab bars, mirror, coat hook and dispensers for toilet paper, towels, and liquid soap.

16.4.4.2 Hoists

Larger facilities may be required to be equipped with overhead hoists for equipment maneuvering.

16.4.4.3 Plumbing

All systems, designs and procedures are to meet or exceed the requirements of the latest issue of the following codes and standards:

a. Kentucky State Plumbing Code
b. Kentucky Building Code
c. Jefferson County Health Department
d. State Department of Housing
e. National Sanitation Foundation
f. Louisville Water Company

A Professional Engineer registered in the Commonwealth of Kentucky must sign and seal all plumbing documents.

All concepts and designs must strike a balance between function, initial and operational cost, and ease of maintenance. Generally accepted designs, materials, and methods are used throughout the project.

a. Design Requirements - The following key issues must be addressed in the design with calculations to verify such:

- Water heater capacity
- Line sizes

1. The following major pieces of equipment must be selected, sized, and specified. Where available, the Design Engineer shall include manufacturer's cut-sheets for each item in the design submittal:

a. Water heater
b. Emergency shower and eyewash
c. Toilet
d. Lavatory
e. Janitor's sink
f. Drinking fountain
g. Floor drains
h. Hose bibbs
i. Wall hydrants
j. Yard hydrants
k. Back flow preventers
l. Traps
m. Piping

2. Provide schematic and/or riser diagrams of all piping systems. Pipe sizes are to be on the risers. Include reference pipe sizes on plan views.

3. Provide equipment schedules on the plans.

4. Provide complete drainage and air venting systems.

b. Facility Design - Indoor facilities must have provisions for the following:

- Toilet
- Lavatory
- Water heater

- Drinking fountain
- Combination emergency shower and eyewash
- Floor drains
- Janitor's sink (determined on case-by-case basis)

1. Determine the approximate fee each utility provider will charge the project. Include this figure as an allowance to the project.

2. Buried water lines are to be ductile iron or Type K copper, soft, with no joints.

3. Buried sewer lines are to be cast iron.

4. Domestic water piping is to be insulated Type L, hard copper with soldered joints of 95-5 Tin-Antimony or approved non-lead solder.

5. Provide external, freeze proof wall hydrants and/or yard hydrants at convenient outdoor locations to limit hose lengths to 100 feet or less.

6. Provide backflow and back siphon protection at the site supply. Dual backflow preventers must also be installed within the site to protect the facility's potable water supply.

7. Soil piping below any slabs will be cast iron.

16.4.4.4 HVAC System

a. General - Heating and ventilation will be designed using American Society of Heating, Refrigerating and Air-conditioning Engineers Handbook. All systems, designs and procedures are to meet or exceed the requirements of the latest issue of the following codes and standards:

- Occupational Safety and Health Administration
- National Fire Protection Association (NFPA)*
- Kentucky State Fire Marshal's Regulations
- Kentucky Building Code (KBC)
- Underwriter's Laboratories, Inc. (UL)
- Factory Mutual System (FM)
- National Electrical Code (NEC)

- Sheet Metal and Air Conditioning Contractor's National Association, Inc. (SMACNA)

*Specifically, NFPA 820, "Recommended Practice for Fire Protection in Wastewater Treatment and Collection Facilities"

All mechanical (HVAC) documents must be signed and sealed by a Professional Engineer registered in the Commonwealth of Kentucky.

All concepts and designs are to strike a balance between function, initial cost, operational cost, and ease of maintenance. Generally accepted designs, materials, and methods are to be used throughout the project.

b. Design Requirements - Outdoor Design Conditions

- Design Parameters Basis: Louisville, Kentucky
- Summer: 92.5% design
  93°F dry bulb (DB)
  74°F wet bulb (WB)
- Winter: 97.5% design
  10°F (DB)

1. At a minimum, the following key issues must be addressed in design with calculations to verify such:

   a. Design conditions (including temperature)
   b. Gross floor area
   c. Gross surface
   d. Thermal transmittance
   e. Heating load
   f. Diversity factor
   g. Duct air velocity range

2. The following major pieces of equipment must be selected, sized, and specified. Where available, the Design Engineer shall include manufacturer's cut-sheets for each item in the design submittal:

   a. Fans (supply and exhaust)
   b. Temperature controls
   c. Roof-curbs and equipment supports

d. Louvers, dampers and intake hoods
e. Ductwork and flues
f. Diffusers, registers and grilles
g. Heating units

3. Provide equipment schedules on the plans.

4. Require air and hydronic systems testing and balancing by a contractor who is independent of related project contractors. The contractor must be a member of Associated Air Balance Council or National Environmental Balancing Bureau.

5. Consider prevailing winds, vents, exhausts, process equipment, in locating air intakes to minimize odors and contaminants from entering the fresh air system.

6. Ductwork and accessories shall be aluminum or stainless steel in conformance with SMACNA HVAC Duct Construction Standards.

7. Diffusers, registers, and grilles shall be extruded aluminum with baked-on enamel finish.

8. Louvers shall be extruded aluminum with anodized finish.

9. Exhaust fan shall be roof-mounted, belt-driven units.

10. Attic areas must be independently vented according to the appropriate building code requirements.

c. Facility Design - The following requirements only apply to areas that are enclosed spaces.

1. *Screening Facilities*

Ventilation

Continuously ventilated at 12 air changes per hour. Consideration should be given to higher ventilation rates when the collection system serves a significant industrial area or is a combined system.

Heating

Design Temperature: 60°F DB

Type

Remote forced-air gas (if gas available) unit with ductwork into space.

Control

Thermostat with occupied/unoccupied override switch.

2. *Pump Stations*

Ventilation

Same as Screening Facilities.

Heating

Design Temperature: 60°F DB

Type

Ceiling hung or wall-mounted unit heaters

Control

Thermostat with occupied/unoccupied override switch.

3. *Chemical Feed Areas*

Ventilation

Chemical rooms must have commercial-grade, corrosion resistant exhaust fans, with backdraft dampers, located for floor-level cross-ventilation. They must be rated for 6 complete air changes per hour on a constant basis, and 60 complete air changes per hour on an intermittent basis. The doorway may not serve as the intake. Provide fan starting via micro-switches in the doorway jambs or weatherproof toggle switches just outside each door. Dampers must close by gravity when the fan de-activates.

Heating

Design Temperature: 60°F

40 degrees F - Chlorine Room

65 degrees F - Sulfur Dioxide Room

Type

Ceiling hung or wall-mounted unit heaters

Control

Wall-mounted Thermostat

4. *Rest Rooms*

Ventilation

Provide commercial-grade, ceiling hung or wall-mounted, corrosion-resistant exhaust fan, direct drive. Fan must be rated for 6 complete air changes per hour or more as required by mechanical code on an irregular basis. The doorway may serve as the intake. Fan should be activated by the light switch.

Heating

Design Temperature: 72°F

Type

Wall-mounted unit heaters

Control

Integral thermostat

5. *Electrical Room*

Ventilation

Provide sufficient ventilation to dissipate heat generated from electrical equipment. Provide outside air intake with backdraft damper. Ventilation shall prevent room temperature from rising higher than 5 degrees above ambient outdoor temperature basis. Fan should be activated by wall-mounted thermostat with manual override.

Heating

Design Temperature: 60°F

Type

Ceiling hung or wall-mounted unit heaters

Control

Wall-mounted thermostat

6. *Blower Room*

Ventilation

Provide sufficient ventilation to dissipate heat generated by the blowers (minimum of 20 complete air changes per hour) on an

intermittent basis. Blower Rooms must be vented using thermostatically operated fans with a manual override to prevent overheating in the summer. Provide outside air intake with backdraft damper. Ventilation shall prevent room temperature from rising higher than 10 degrees above ambient outdoor temperature.

Heating

Design Temperature: 45°F

Type

Ceiling hung or wall-mounted unit heaters

Control

Wall-mounted thermostat

16.4.4.5 Electrical System

a. General - This section provides guidelines for the design and preparation of plans and specifications as related to small WWTP power, instrumentation, and control.

All electrical documents must be signed and sealed by a Professional Engineer currently registered in the Commonwealth of Kentucky.

All concepts and designs are to strike a balance between function, initial cost, operational cost and ease of maintenance. Generally accepted designs, materials and methods are to be used throughout the project. If, however, the Design Engineer identifies an opportunity to take advantage of an innovative design approach, the Design Engineer is to present the proposal in writing to MSD for evaluation.

All systems, designs and procedures are to meet or exceed the requirements of the latest issue of the following codes or standards:

- Kentucky Building Code (KBC)
- National Electrical Code (NEC)
- Underwriter's Laboratories, Inc. (UL)
- Factory Mutual System (FM)
- National Fire Protection Association (NFPA)*
- National Electrical Manufacturers Association (NEMA)

- Occupational Safety and Health Administration (OSHA)
- Illuminating Engineering Society of North America (IES)
- Instrument Society of America (ISA)
- Institute of Electrical and Electronic Engineers (IEEE)
- Certified Ballast Manufacturer's Association (CBM)
- American National Standards Institute, Inc. (ANSI)
- Lightning Protection Institute (LPI)
- Joint Industry Council (JIC)
- Kentucky Occupational Safety and Health Administration (KYOSHA)

*Designs should relate to the following specific requirements:

- NFPA 37 "Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines" (if applicable)
- NFPA 110 "Standard for Emergency and Standby Power Systems" (if applicable)
- NFPA 820 "Recommended Practice for Fire Protection in Wastewater Treatment and Collection Facilities"

b. Design Requirements - At a minimum, the following key issues must be addressed in the design with calculations and/or NEC references to verify such:

1. Service size
2. Feeder/service conductor size
3. Ground conductor size
4. Branch circuit conductor size
5. Branch circuit overcurrent protection type and rating
6. Motor controllers size, magnetic trip and overload protection rating
7. Feeder/service disconnect size
8. Feeder/service overcurrent protection
9. Ground fault protection if required
10. Available fault current on a per unit basis
11. Coordination study
12. Spare capacity for future growth (where appropriate)
13. Lighting calculations

c. Facility Design - The following major pieces of equipment must be selected, sized, and specified. The Design Engineer shall include manufacturer's cut-sheets for each item designated with an asterisk (*) in the design submittal. These items shall include but not be limited to the following:

1. Electrical:

   a. Wire/conduit
   b. Wiring devices (receptacles, switches, etc.)
   c. Cabinets and enclosures
   d. Transformers
   e. Capacitors
   f. Switchgear*
   g. Manholes/pullboxes
   h. Disconnect switches
   i. Panelboards
   j. Circuit breakers/fuses
   k. Motor control centers*
   l. Starters*
   m. Relays and timers
   n. Control devices (push buttons, indicator lights, etc.)
   o. Light fixtures*
   p. Transfer switch*
   q. Emergency generator*
   r. Fuel storage tank*
   s. Automatic dialer

2. Instrumentation

   a. Flow*
   b. Pressure*
   c. Recorders*
   d. Chlorinators
   e. Leak detector
   f. Instrument tubing

The WWTP shall be wired in strict accordance with the latest edition of the NEC. Pumps and equipment shall normally be designed to be operated from a 460 volt, three-phase power source. No single phase to three phase converters will be allowed.

Reduced-voltage starting, if required, shall utilize solid-state motor starters with bypass contactors. The solid-state starters shall be

used to start and stop the pumps with the bypass contactor utilized for full pump speed. Consult with LG&E for motor starting requirements.

Single-phase pumps shall have capacitor start motors.

Motors greater than 5 horsepower shall have capacitors for power factor correction.

d. Drawings - Power and lighting plans shall be provided. Control wiring plans shall be provided to show interconnecting wiring between control panels and associated field devices, equipment and other control panels.

1. The entire WWTP electrical system shall be depicted on a "One-Line Diagram". It shall include the following information:

- Service size
- Feeder sizes
- Motor starter sizes
- Circuit breaker/fuse sizes
- Metering arrangement
- Horsepower ratings
- Motor control center horizontal bus ratings
- Transfer switching arrangement
- Emergency generator
- Grounding

2. Adequate space shall be provided inside for a motor control center. Show a plan view of the MCC and a front elevation.

3. Provide a light fixture schedule on the plans.

4. Provide an individual control wiring schematic for each motor. At a minimum, address the following:

a. Manual/automatic control
b. Alarms
c. Remote interlocks (level control, flow control, seal water, etc.)
d. Status

5. Provide a power site plan.

6. Provide a circuit schedule, indicating "from", "to", number and size of conductors, and type of circuit (power, control, instrumentation).

7. Provide electrical/instrumentation installation details.

8. Overload relays shall be resettable without opening enclosure doors.

9. All wiring shall be 600 volt, type THW run in conduit.

10. Direct bury cable will not be allowed.

11. Conduit shall be galvanized rigid steel for interior and exterior areas, PVC schedule 40 for below grade. In potentially high corrosive areas, PVC coated rigid steel conduit shall be required.

12. Electrical equipment enclosures in wet or damp locations and chemical areas shall be stainless steel NEMA 4X enclosures.

13. If chlorine gas is utilized for disinfection, leak detectors must be provided in the Chlorine Facilities. It should be connected to an audible and visual alarm as well as the telemetry system.

14. Lower explosive limit (LEL), hydrogen sulfide (H_2S), and oxygen (O_2) detection systems may be required. If required, it shall be connected to an audible and visual alarm as well as the telemetry system. MSD will evaluate the need for this equipment on a case-by-case basis.

15. Provisions for submersible pump control shall be as outlined in Section 13.5.

16. In general, indoor lighting fixtures will be fluorescent type (commercial, industrial or vapor light). Fluorescent lamps should be T8 with electronic ballast. Vapor tight lighting fixtures will be used in wet or damp locations and in chemical storage and handling areas. Indoor area with mounting heights of 15 feet and above will have high pressure sodium fixtures.

17. Outside roadway and area lighting will have high pressure sodium, pole-mounted light fixtures. All structures such as clarifiers, ditches, etc., will have adequate lighting to perform normal plant operations at night. Whenever electrical service is supplied via overhead lines, utility pole-mounted lighting supplied and maintained by LG&E shall be used to the maximum extent possible.

18. Emergency, battery operated lighting units will be used where required to meet code.

19. The following levels of illumination shall be maintained:

    a. Roadways: 1-2 footcandles
    b. Walkways/sidewalks: 1-2 footcandles
    c. Clarifiers, ditches, tankage, etc.: 5 footcandles
    d. Building entrances: 5 footcandles
    e. Mechanical equipment areas: 30 footcandles
    f. Corridors: 20 footcandles
    g. Rest rooms: 30 footcandles
    h. Electrical room: 30 footcandles
    i. Storage areas: 20 footcandles

20. Provisions for emergency standby power shall be evaluated on an individual site basis.

21. Permanent in-place electrical generators powered by natural gas or diesel-fuel internal combustion engines shall be provided. These stations shall be totally automatic and shall include all necessary transfer switches and other components. The electrical generators shall be housed in a weatherproof enclosure.

22. For diesel-fueled systems an above ground fuel tank with containment basin shall be provided. Also, include leak detection and alarm.

23. Transfer switches shall be provided with a time-delayed neutral position.

24. When two independent public electrical utility sources are available, the requirements for in-place generators may be waived by MSD.

25. At this time MSD is in the process of phasing out the requirement for an automatic telephone dialer. Designers will need to contact MSD for the current telemetry requirements.

16.4.5 Safety Requirements

16.4.5.1 Codes

The following code requirements, as applicable to WWTPs, must be incorporated into the design: appropriate building code, Kentucky Plumbing Code, Occupational Safety and Health Administration (OSHA), Kentucky Occupational Safety and Health Administration (KYOSHA), National Electric Code (NEC), and National Fire Protection Association (NFPA).

16.4.5.2 Machinery Guards

All belts, pulleys, and drive shafts must have guards conforming to OSHA or the manufacturer's specs., whichever is more stringent.

16.4.5.3 Railings

Provide aluminum railings on both sides of gratings and stairs. Provide aluminum toe plates as required by OSHA. Railings should be capable of supporting 200 lbs of dead weight. Vertical height must be 42 inches tall with no gap between the horizontals greater than 16 inches. Aluminum railings shall be fabricated by welding or by using manufacturer's standard fittings. Riveted connections are not allowed. Four-inch toe plates are required.

16.4.5.4 Stairs and Ladders

Stairs, rather than ladders, must be used wherever possible. Stair slope must not exceed 40 degrees and must conform with the building code. Spiral stairs are not allowed. Ladder rails must extend 4 feet higher than the surrounding upper level elevation to facilitate ladder access; rungs must be on 12-inch centers.

16.4.5.5 Walkways and Grating

Safe access to all operation and maintenance locations (valves, areas requiring routine cleaning, sampling locations, etc.) must be

provided. Walkways and catwalks must be free of hazards. Grating must be aluminum or galvanized steel, flat rectangular grid (1.25-inch x 0.125-inch) and must not interlock. Grating support must not deflect more than L/180 inches under 200 lb/ft^2 uniform load (L = span of the grating, in inches measured from outside edge to outside edge).

16.4.5.6 Electrical Safety

Exterior control enclosures shall have an outer door that conceals an inner door. The inner door shall contain all operator interface components such as selector switches, pushbuttons, pilot lights, etc.

16.5 OPINIONS OF COST

Opinions of probable cost shall be based on the best professional opinions of the Design Engineer. MSD's Master Estimator, recent bid tabulations and information from suppliers and contractors should be used by the Design Engineer in formulating the opinions of cost.

16.5.1 Opinions of Capital Cost

Opinions of capital cost shall be in Construction Specification Institute (CSI) format and shall be grouped by category. Opinions of capital cost shall include a construction contingency of 3 percent and should include a cost for necessary land, easement, or right-of-way acquisition.

16.5.2 Opinions of Operation and Maintenance Cost

Opinions of operation and maintenance cost shall include costs for labor, utilities, maintenance, and repair.