MISSOURI
DEPARTMENT OF
NATURAL RESOURCES

Title 10—DEPARTMENT OF NATURAL RESOURCES
Division 20—Clean Water Commission
Chapter 8—Minimum Design Standards

WORKING DOCUMENT

Strawman

The Department presents these draft materials for stakeholder review and discussion only.
Subject to the Red Tape Reduction review.

The Missouri Department of Natural Resources has identified 10 CSR 20-8, Minimum Design Standards, as a potential rulemaking amendment. This workgroup has been convened for the purpose of informal and voluntary public participation and discussions regarding the development of this rule prior to initiating formal rulemaking.

Under Governor Greitens' leadership, all state agencies are working to reduce regulations and other government processes that unnecessarily burden individuals and businesses while doing little to protect or improve public health, safety, and our natural resources. The Missouri Department of Natural Resources is committed to limiting regulation to what is necessary to protect Missouri's environment, implementing statutory mandates, and maintaining state control of programs. Any further proposed changes to rules discussed on this page are being developed with these goals in mind. We welcome your comments to help ensure that our regulations provide required protections but do not add unnecessary costs.

Title 10—DEPARTMENT OF NATURAL RESOURCES
Division 20—Clean Water Commission
Chapter 8—*[Design Guides]* Minimum Design Standards

10 CSR 20-8.210 Supplemental Treatment *[Processes]*.

[PURPOSE: The following criteria have been prepared as a guide for the design of supplemental treatment processes. This rule is to be used with rules 10 CSR 20-8.110– 10 CSR 20-8.220 for the planning and design of the complete treatment facility. This rule reflects the minimum requirements of the Missouri Clean Water Commission as regards adequacy of design, submission of plans, approval of plans, and approval of completed sewage works. Deviation from these minimum requirements will be allowed where sufficient documentation is presented to justify the deviation. These criteria are taken largely from Great Lakes-Upper Mississippi River Board of State Sanitary Engineers Recommended Standards for Sewage Works and are based on the best information presently available. These criteria were originally filed as 10 CSR 20-8.030. It is anticipated that they will be subject to review and revision periodically as additional information and methods appear. Addenda or supplements to this publication will be furnished to consulting engineers and city engineers. If others desire to receive addenda or supplements, please advise the Clean Water Commission so that names can be added to the mailing list.]

PURPOSE: The following minimum criteria have been prepared as a standard for the design of wastewater systems. This rule is to be used with rules 10 CSR 20-8.110 through 10 CSR 20-8.500 for the planning and design of a treatment facility. It is not reasonable or practical to include all aspects of design in these standards. The design engineer may use other appropriate reference materials for these design aspects not addressed in this rule, which include but are not limited to: copies of all ASTM International and American Water Works Association (AWWA) standards pertaining to wastewater systems and appurtenances, design manuals such as Water Environment Federation's Manuals of Practice, Department prepared guides and other wastewater design manuals containing principles of accepted engineering practice. This rule specifies minimum standards for the design and construction of wastewater systems, in addition to engineering experience and judgement in accordance with standards of practice.

[(1) Definitions. Definitions as set forth in the ***Missouri*** *Clean Water Law and 10 CSR 20-2.010 shall apply to those terms when used in this rule, unless the context clearly requires otherwise. Where the terms shall and must are used, they are to mean a mandatory requirement insofar as approval by the agency is concerned, unless justification is presented for deviation from the requirements. Other terms, such as should, recommend, preferred and the like, indicate discretionary requirements on the part of the agency and deviations are subject to individual consideration.*

(2) Exceptions This rule shall not apply to facilities designed for twenty-two thousand five hundred (22,500) gallons per day (85.4 m^3) or less (see 10 CSR 20-8.020 for the requirements for those facilities).]

(1) Applicability. Wastewater systems shall be designed based on criteria contained in this rule, published standards, applicable federal and state requirements, standard textbooks,

current technical literature and applicable safety standards. To the extent of any conflict between the above criteria, the requirement in this rule shall prevail.

(A) This rule shall not apply to animal waste management systems. Regulations for these facilities are found in 10 CSR 20-8.300.

(B) This rule shall not apply to agrichemical facilities. Regulations for these facilities are found in 10 CSR 20-8.500.

[(3) Phosphorus Removal by Chemical Treatment.

(A) General.

1. Method. Addition of line or the salts of aluminum or iron may be used for the chemical removal of soluble phosphorus. The phosphorus reacts with the calcium, aluminum or iron ions to form insoluble compounds. These insoluble compounds may be coagulated with or without the addition of a coagulant aid such as polyelectrolyte to facilitate separation by sedimentation.

2. Design basis. Laboratory, pilot or full scale trial of various chemical feed systems and treatment processes are recommended to determine the performance level achievable, cost-effective design criteria and ranges of chemical dosages required. Systems shall be designed with sufficient flexibility to allow for several operational adjustments in chemical feed point location, chemical feed rates and for feeding alternate chemical compounds.

(B) Process Requirements.

1. Dosage. The chemical dosage required shall include the amount needed to react with the phosphorous in the wastewater, the amount required to drive the chemical reaction to the desired state of completion and the amount required due to inefficiencies in mixing or dispersion. Excessive chemical dosage should be avoided.

2. Chemical selection. The choice of lime or the salts of aluminum or iron should be based on the wastewater characteristics and the economics of the total system. When lime is used it may be necessary to neutralize the high pH prior to subsequent treatment in secondary biological systems or prior to discharge in those flow schemes where lime treatment is the final step in the treatment process.

3. Chemical feed points. Selection of chemical feed points shall include consideration of the type of chemicals used in the process, necessary reaction times between chemical and polyelectrolyte additions, and the type of wastewater treatment processes and components utilized. Considerable flexibility in feed point location should be provided, and multiple feed points are recommended.

4. Flash mixing. Each chemical must be mixed rapidly and uniformly with the flow stream. Where separate mixing basins are provided, they should be equipped with mechanical mixing devices. The detention period should be at least thirty (30) seconds.

5. Flocculation. The particle size of the precipitate formed by chemical treatment may be very small. Consideration should be given in the process design to the addition of synthetic polyelectrolytes to aid settling. The flocculation equipment should be adjustable in order to obtain optimum flow growth, control deposition of solids and prevent floc destruction.

6. Liquid—solids separation. The velocity through pipes or conduits from flocculation basins to settling basins should not exceed 1.5 feet per second (0.46 m/s) in order to minimize floc destruction. Entrance works to settling basins should also be designed to minimize floc shear. Settling basin design shall be in accordance with criteria outlined in 10

CSR 20-8.160. For the design of a sludge handling system, special consideration should be given to the type and volume of sludge generated in the phosphorus removal process.

7. Filtration. Effluent filtration shall be considered where effluent phosphorus concentrations of less than one (1) mg/l must be achieved.

(C) Feed Systems.

1. Location. All liquid chemical mixing and feed installations should be installed in corrosion-resistant pedestals and elevated above the highest liquid level anticipated during emergency conditions. Lime feed equipment should be located so as to minimize the length of slurry conduits. All slurry conduits shall be accessible for cleaning.

2. Liquid chemical feed system. Liquid chemical feed pumps should be of the positive displacement type with variable feed rate control. Pumps shall be selected to feed the full range of chemical quantities required for the phosphorus mass loading conditions anticipated with the largest unit out-of-service. Screens and valves shall be provided on the chemical feed pump suction lines. An air break or antisiphon device shall be provided where the chemical solution discharges to the transport water stream to prevent an induction effect resulting in overfeed. Consideration shall be given to providing pacing equipment to optimize chemical feed rates.

3. Dry chemical feed system. Each dry chemical feeder shall be equipped with a dissolver which is capable of providing a minimum five (5)-minute retention at the maximum feed rate. Polyelectrolyte feed installations should be equipped with two (2) solution vessels and transfer piping for solution makeup and daily operation. Makeup tanks shall be provided with an eductor funnel or other appropriate arrangement for wetting the polymer during the preparation of the stock feed solution. Adequate mixing should be provided by a large diameter, low-speed mixer.

(D) Storage Facilities.

1. Size. Storage facilities shall be sufficient to insure that an adequate supply of the chemical is available at all times. Exact size required will depend on size of shipment, length of delivery time and process requirements. Storage for a minimum of ten (10) days' supply should be provided.

2. Location. The liquid chemical storage tanks and tank fill connections shall be located within a containment structure having a capacity exceeding the total volume of all storage vessels. Valves on discharge lines shall be located adjacent to the storage tank and within the containment structure. Auxiliary facilities, including pumps and controls, within the containment area shall be located above the highest anticipated liquid level. Containment areas shall be sloped to a sump area and shall not contain floor drains. Bag storage should be located near the solution makeup point to avoid unnecessary transportation and housekeeping problems.

3. Accessories. Platforms, ladders and railings should be provided as necessary to afford convenient, safe access to all filling connections, storage tank entries and measuring devices. Storage tanks shall have reasonable access provided to facilitate cleaning.

(E) Other Requirements.

1. Materials. All chemical feed equipment and storage facilities shall be constructed of materials resistant to chemical attack by all chemicals normally used for phosphorous treatment.

2. Temperature/humidity and dust control. Precautions shall be taken to prevent chemical storage tanks and feed lines from reaching temperatures likely to result in freezing or

chemical crystallization at the concentrations employed. A heated enclosure or insulation may be required. Consideration should be given to temperature, humidity and dust control in all chemical feed room areas.

3. Cleaning. Consideration shall be given to the accessibility of piping. Piping should be installed with plugged wyes, tees or crosses at changes in direction to facilitate cleaning.

4. Drains and drawoff. Above-bottom drawoff from chemical storage or feed tanks shall be provided to avoid withdrawal of settled solids into the feed system. A bottom drain shall also be installed for periodic removal of accumulated settled solids.

(F) Hazardous Chemical Handling. The requirements of 10 CSR 20-8.140(9)(A) shall be met.

(G) Sludge Handling.

1. General. Consideration shall be given to the type and additional capacity of the sludge handling facilities needed when chemicals are used.

2. De-watering. Design of de-watering systems should be based, where possible, on an analysis of the characteristics of the sludge to be handled. Consideration should be given to the ease of operation, effect of recycle streams generated, production rate, moisture content, de-waterability, final disposal and operating costs.]

(2) Polishing Reactors.

(A) Design. The process shall—

1. Provide a minimum hydraulic retention time of three (3) hours;

2. Be based on actual influent characteristics into the reactor for:

A. Removal of oil, grease, scum, grit and floating debris; and

B. Biological Oxygen Demand and Total Suspended Solids, but sized for a Biochemical Oxygen Demand loading of no more than forty eight pounds per one thousand cubic feet per day (48 lbs BOD/1,000 cf/day);

3. Be sized using less than two tenths a pound TKN per one thousand square feet per day (0.2 lbs TKN/1,000 ft^2/day) when nitrifying;

4. Provide sufficient alkalinity with a minimum residual of fifty milligrams per liter (50 mg/L) in the effluent or include chemical treatment;

5. Include cold weather provisions, including heaters, insulated covers, installation of temperature controlled enclosures for above-ground components to prevent freezing and to ensure ammonia removal; and

6. Provide a blower malfunction alarm able to notify the operator of alarm activations through audio-visual means.

(3) Filtration.

(A) Filtration systems shall be preceded with additional process, such as chemical coagulation and sedimentation or other acceptable process, when:

1. Permit requirements for suspended solids are less than ten milligrams (10 mg/l);

2. Effluent quality is expected to fluctuate significantly;

3. Significant amounts of algae are present; or

4. The manufacturer recommends.

(B) General Design.

1. Filtration systems shall have:

A. Convenient access to all components and the media surface for inspection and maintenance without taking other units out of service;

B. Enclosed controls and heating and ventilation equipment to control humidity; and

C. The capacity to handle the maximum wastewater flow with the largest unit out of service utilizing a minimum of two (2) units.

2. Flocculation. For filtration systems requiring coagulation and flocculation prior to the filtration, the flocculation system shall:

A. Include chemical feed equipment to meet the system's anticipated peak design flow and the ability to proportion chemical feed rates; and

B. Ensure the rapid dispersion and mixing of chemicals throughout the wastewater by providing mechanical or in-line static mixers.

(C) Deep bed filters.

1. The design of manifold type filtrate collection or underdrain systems shall:

A. Minimize loss of head in the manifold and baffles;

B. Provide the ratio of the area of the underdrain orifices to the entire surface area of the filter media at about 0.003;

C. Provide the total cross-sectional area of the laterals at about twice the area of the final openings; and

D. Provide a manifold which has a minimum cross sectional area that is one and half (1.5) times the total area of the laterals.

2. All rotary surface wash devices shall:

A. Provide a minimum wash water pressure of forty pounds per square inch (40 psi);

B. Provide adequate surface wash water to provide half to one gallon per minute per square foot (0.5-1.0 gpm/ sq ft) of filter area.

(D) Shallow bed filters. The shallow bed filter shall:

1. Not exceed two gallons per minute per square foot (2 gpms/ sq ft) of filter area at average design flow;

2. Provide multiple unit operations to allow for continuous operability and operational variability;

3. Include filter media consisting of a series of up to eight inch filter increments having a minimum total media depth of eleven inches (11"). For sand media, use an effective size in the range of 0.40 mm to 0.65 mm and a uniformity coefficient of 1.5 or less;

4. Include inlet ports located throughout the length of the filter.

5. Provide an underdrainage system along the entire length of the filter so that filter effluent is uniformly withdrawn without clogging outlet openings.

6. Have a traveling bridge mechanism which provides support and access to the backwash pumps and equipment; is constructed of corrosion resistant materials; provides for consistent tracking of the bridge; provides support of the power cords; and initiates a backwash cycle automatically when a preset head loss through the filter media occurs.

(E) Cloth/Disc Filters.

1. Media Design. The media shall:

A. Have an average pore size of no larger than thirty (30) microns;

B. Follow the manufacturer's recommendations; and

C. Be chemical-resistant if the filter will be exposed to chemicals, such as chlorine or disinfectants.

2. Filtration Rates and Hydraulics. The design shall:

A. Base the filtration rate on the effective submerged surface area of the media but provide a maximum filtration rate for peak flow of not more than six and half gallons per minute per square foot (6.5 gpm/sq ft) of submerged media;

B. Be able to treat the design flow rate with one (1) filter unit in backwash mode.

[(4) High Rate Effluent Filtration.

(A) General.

1. Applicability. Granular media filters may be used as a tertiary treatment device for the removal of residual suspended solids from secondary effluent. Where effluent suspended solids requirements are less than ten (10) mg/l, where secondary effluent quality can be expected to fluctuate significantly or where filters follow a treatment process where significant amounts of algae will be present, a pretreatment process such as chemical coagulation and sedimentation or other acceptable process should precede the filter units. Pretreatment units shall meet the applicable requirements of section (3) of this rule.

2. Design consideration. Care should be given in the selection of pumping equipment ahead of filter units to minimize shearing of floc particles. Consideration should be given in the plant design to providing flow equalization facilities to moderate filter influent quality and quantity.

(B) Filter Types. Filters may be of the gravity-type or pressure-type.

1. Pressure filters shall be provided with ready and convenient access to the media for treatment or cleaning.

2. Where greases or similar solids which result in filter plugging are expected, filters should be of the gravity-type.

(C) Filtration Rates.

1. Allowable rates. Filtration rates shall not exceed five (5) gallons per minute per square foot based on the maximum hydraulic flow rate applied to the filter units.

2. Number of units. Total filter area shall be provided in two (2) or more units, and the filtration rate shall be calculated on the total available filter area with one (1) unit out-of-service.

(D) Backwash.

1. The backwash rate shall be adequate to fluidize and expand each media layer a minimum of twenty percent (20%) based on the media selected. The backwash system shall be capable of providing a variable backwash rate having a maximum of at least twenty (20) gpm/sq. ft. (13.6 l/m^2/s) and a minimumbackwash period of ten (10) minutes.

2. Backwash. Pumps for backwashing filter units shall be sized and interconnected to provide the required rate to any filter with the largest pump out-of-service. Filtered water should be used as the source of backwash water. Waste filter backwash water shall be adequately treated.

(E) Filter Media.

1. Selection. Selection of proper media size will depend on the filtration rate selected, the type of treatment provided prior to filtration, filter configuration and effluent quality objectives. In dual or multi-media filters, media size selection must consider compatibility among media.

2. Media specifications. The following table provides a listing of the normal acceptable range of media sizes and minimum media depths. The designer has the responsibility for

selection of media to meet specific conditions and treatment requirements relative to the project under consideration.

Media Sizes, mm and Minimum Depths, (in)

	Single Media	*Dual Media*	*Multi Media*
Anthracite	*—*	*1.0–2.0 (20")*	*1.0–2.0 (20")*
Sand	*1.0–4.0 (48")*	*0.5–1.0 (12")*	*0.6–0.8 (10")*
Garnet or Similar—Material	*—*	*0.3–0.6 (2")*	

Uniformity Coefficient shall be 1.7 or less.

(F) Filter Appurtenances. The filters shall be equipped with washwater troughs, surface wash or air scouring equipment, means of measurement and positive control of the backwash rate, equipment for measuring filter head loss, positive means of shutting off flow to a filter being backwashed and filter influent and effluent sampling points. If automatic controls are provided, there shall be a manual override for operating equipment, including each individual valve essential to the filter operation. The underdrain system shall be designed for uniform distribution of backwash water (and air, if provided) without danger of clogging from solids in the backwash water. Provision shall be made to allow periodic chlorination of the filter influent or backwash water to control slime growths.

(G) Reliability. Each filter unit shall be designed and installed so that there is ready and convenient access to all components and the media surface for inspection and maintenance without taking other units out-of-service. The need for housing of filter units shall depend on expected extreme climatic conditions at the treatment plant site. As minimum, all controls shall be enclosed. The structure housing filter controls and equipment shall be provided with adequate heating and ventilation equipment to minimize problems with excess humidity.

(H) Backwash Surge Control. The rate of return of waste filter backwash water to treatment units shall be controlled so that the rate does not exceed fifteen percent (15%) of the design average daily flow rate to the treatment units. The hydraulic and organic load from waste backwash water shall be considered in the overall design of the treatment plant. Surge tanks shall have a minimum capacity of two (2) backwash volumes, although additional capacity should be considered to allow for operational flexibility. Where waste backwash water is returned for treatment by pumping, adequate pumping capacity shall be provided with the largest unit out-of-service.

(I) Backwash Water Storage. Total backwash water storage capacity provided in an effluent clearwell or other unit shall equal or exceed the volume required for two (2) complete backwash cycles.

(J) Proprietary Equipment. Where proprietary filtration equipment not conforming to the preceding requirements is proposed, data which supports the capability of the equipment to

meet effluent requirements under design conditions shall be provided. The equipment will be reviewed on a case-by-case basis at the discretion of the agency.]

*[(5)]***(4)** Microscreening.

[(A) General.

1. Applicability. Microscreening units may be used following a biological treatment process for the removal of residual suspended solids. Selection of this unit process should consider final effluent requirements, the preceding biological treatment process and anticipated consistency of biological process to provide a high quality effluent.

2. Design considerations. Pilot plant testing on existing secondary effluent is encouraged. Where pilot studies so indicate, where microscreens follow trickling filters or lagoons, or where effluent suspended solids requirements are less than ten (10) mg/l, a pretreatment process such as chemical coagulation and sedimentation shall be provided. Care should be taken in the selection of pumping equipment ahead of microscreens to minimize shearing of floc particles. The process design shall include flow equalization facilities to moderate microscreen influent quality and quantity.

(B)] **(A)** Screen Material. The microfabric shall be a material demonstrated to be durable through long-term performance data. *[The aperture size must be selected considering required removal efficiencies, normally ranging from twenty to thirty-five (20–35) microns. The use of pilot plant testing for aperture size selection is recommended.*

(C) Screening Rate. The screening rate shall be selected to be compatible with available pilot plant test results and selected screen aperture size, but shall not exceed five (5) gallons per minute per square foot (3.40 l/m^2/s) of effective screen area based on the maximum hydraulic flow rate applied to the units. The effective screen area shall be considered the submerged screen surface area less the area of screen blocked by structural supports and fasteners. The screening rate shall be that applied to the units with one (1) unit out-of-service.

(D)] **(B)** Backwash. All *[waste]* backwash *[water generated by the microscreening operation]* shall be recycled for treatment.

[1. The backwash volume and pressure shall be adequate to assure maintenance of fabric cleanliness and flow capacity.

2. Equipment for backwash of at least eight (8) gallons per minute per linear foot (1.66 l/m/s) of screen length and sixty (60) pounds per square inch (4.22 kgf/cm^2), respectively, shall be provided.

3. Backwash water shall be supplied continuously by multiple pumps, including one (1) standby and should be] obtained from microscreened effluent.

4. The rate of return of waste backwash water to treatment units shall be controlled so that the rate does not exceed fifteen percent (15%) of the design average daily flow rate to the treatment plant.

5. The hydraulic and organic load from waste backwash water shall be considered in the overall design of the treatment plant.

6. Where waste backwash water is returned for treatment by pumping, adequate pumping capacity shall be provided with the largest unit out-of-service.

7. Provisions should be made for measuring backwash flow.

(E) Appurtenances. Each microscreen unit shall be provided with automatic drum speed controls, with provisions for manual override, a bypass weir with an alarm for use when the screen becomes blinded to prevent excessive head development, and means for de-watering the

unit for inspection and maintenance. Bypassed flows must be segregated from water used for backwashing. Equipment for control of biological slime growths shall be provided. The use of chlorine should be restricted to those installations where the screen material is not subject to damage by the chlorine.

(F) Reliability. A minimum of two (2) microscreen units shall be provided, each unit being capable of independent operation. A supply of critical spare parts shall be provided and maintained. All units and controls shall be enclosed in a heated and ventilated structure with adequate working space to provide for ease of maintenance.]

(5) Chemical Addition.

(A) Acids. Acids shall—

1. Be kept in closed acid resistant shipping containers or storage units;

2. Be pumped in undiluted form from original containers through suitable piping to the point of treatment or to a tightly sealed, vented and covered day tank not handled in open vessels; and.

3. Not be stored in the same area as sodium chlorite and sodium chlorate solutions or in chlorine feed or storage rooms or in any area that may be affected by a chlorine gas leak or vapors from chlorine solutions or compounds.

(B) Carbon dioxide. Plants generating carbon dioxide from combustion shall have open top recarbonation tanks in order to dissipate carbon monoxide and carbon dioxide.

(6) Diffusers.

(A) General.

1. The mixing zone shall not encroach on a drinking water intake, recreation area, or sensitive habitat, overlap the next downstream outfall, or occlude a downstream tributary.

2. Installation of the diffuser will require notification and an Army Corps of Engineers permit.

(B) Diffuser Design Criteria.

1. The pipeline shall be contained within approved property boundaries or easements.

2. Maximum port velocity shall not exceed fifteen feet per second (15 fps).

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*Original authority 1972, amended 1973, 1987, 1993.