**Section 930.20 Treatment Plant**

A non-community water system, semi-private water system, or a private water system which obtains water from a surface source, shall treat water by utilizing a water treatment plant with either slow sand filtration or cartridge filtration, and disinfection.

a) General

1) Raw Water Quality. The turbidity of the source water shall not exceed 50 nephelometric turbidity units. Cartridge filtration shall not be used to treat water obtained from rivers.

2) Intake. A means must be provided to withdraw raw water from the surface source. Intakes shall not incorporate a submerged sand and gravel filter. The intake must be located at a point of deepest water in the pond and must be capable of being raised or lowered for cleaning. A coarse meshed screen with openings not greater than ¼ inch shall be placed over the end of the intake pipe to prevent entrance of fish, dead leaves, and other debris. The intake pipe must be constructed such that it is flexible, will not break when raised, and shall be approved for use as potable water piping in accordance with the Illinois Plumbing Code (77 Ill. Adm. Code 890, Section 890.Appendix A Plumbing Materials, Equipment, Use Restrictions and Applicable Standards) or Table A Approved Materials for Water Service Pipe of this Part. The intake pipe must be kept below any ice, it must be buried in a trench through shallow water, and it must be placed below the frost line at all points.

b) Slow Sand Filtration. The treatment plant shall include the following principal units.

1) Raw Water Pump. A pump shall be required to deliver water from the intake to the filter at a rate which is greater than the filtration rate. The pump must be self-priming or so installed that it will not lose its prime.

A) The pump shall be driven by an electric motor, controlled by a sensing system on top of the filter, and set to start and stop the raw water pump automatically. The system shall be set to allow 10 inch-12 inch fluctuation in the water level in the filter to prevent frequent cycling of the pump.

B) The raw water pump will not be required when the elevation of the filter is below the elevation of the intake pipe. Elevation difference between the pond and the filter must be sufficient to produce the flow rate needed at times of low pond water levels in accordance with the rates set forth in Section 930.30 of this Part. There must be no possibility of flooding the treatment plant by high water which may occur below the pond.

2) Filter Sand. The filter must be designed so that the raw water flows downward by gravity through the filter media.

A) Filter Sand. The filter media shall be a layer of sand at least three feet in depth. The sand shall have an effective size of .25-.35 mm with an ideal size of .30 mm and a uniformity coefficient of 1.4-1.8 with an ideal uniformity coefficient of 1.6. The sand shall be supported by a bed of gravel one foot in depth. A perforated pipe must be installed at the bottom of the filter which will allow water to flow to a water storage tank.

B) Filtration Rate. The maximum permissible filtration rate shall be 2 gallons per minute for each 25 square feet of sand surface area. The amount of water needed per day shall be calculated using Table B.

C) Construction. The filter must be constructed of concrete or a material which will not corrode or deteriorate and the walls and bottom shall be watertight. Examples of materials which will corrode or deteriorate include wood, tin, or steel. The minimum height of the filter shall be 8 feet in order to provide for a 3 foot depth of water above the sand, and a minimum of 1 foot from water level to the top of the filter during operation.

D) Underdrain Pipe. A perforated underdrain pipe, 1¼ inches inside diameter or larger, shall be installed horizontally at 2 inches above the bottom of the filter tank. One end of the pipe shall be capped within the filter to prevent the entrance of gravel. The other end shall pass through the filter wall, and a valve shall be installed to regulate the flow of water leaving the filter. See Illustration A. Forty -50 holes in the underdrain pipe shall be drilled in 2 rows at a 90o angle to each other on the bottom side of the pipe. The holes shall be ¼ inch in diameter and shall be uniformly spaced. One separate underdrain pipe shall be installed for each 75 square feet of filter area.

E) Gravel. Clean, washed gravel shall be placed in three graded layers in the filter, the coarsest gravel being on the bottom. The bottom layer shall be placed to a depth of 6 inches, and shall consist of stones ½-¾ inches in diameter. The top of the pipe shall be 2 inches below the top of this layer. The second or middle layer shall be 3 inches in depth and shall consist of stones ¼-½ inches in diameter. The third or top layer shall be 3 inches in depth and consist of stones ⅛-¼ inches in diameter.

F) Filter Valves. The piping which carries the water from the filter is to be valved as shown in Illustration B. The filter to waste pipe shall discharge at least 6 inches above the floor drain to permit checking the clarity of the filtered water and to measure the flow rate of filtered water. The floor drain shall not be located over the filtered water storage tank nor shall any portion of the waste drain piping pass through any part of the water storage tank. The filtered water shall be stored in the storage tank and a float valve shall be installed at the end of the filtered water pipe within the storage tank to shut off the flow when the tank is filled to approximately 6 inches from the top. (See Illustration A for exact location.) Solenoid valves controlled by a float switch may also be used. A manhole shall be installed in the top of the storage tank. The manhole shall have a raised curb and be provided with a cover of the overhanging type. The float valve is to be located to one side of the manhole so that it may be reached for any adjustment, without entering the storage tank. The floor drain which receives filtered water and discharges to waste shall discharge at ground level, at least 15 feet horizontally and downgrade from the plant and above any floodwater level. This drain shall not be connected to any other drain or sewer.

G) Filtered Water Storage Tank. A watertight and pollution-proof reservoir must be provided to receive the filtered water. Its capacity shall be at least equal to the amount of water which will be used in one day. This amount is obtained by using Table B. The top of the storage tank shall not be higher than the bottom of the filter, and shall not be located where it can be subject to flooding. Sources of pollution shall not be located closer to buried water storage tanks than indicated in Section 920.50 of the Illinois Water Well Construction Code (77 Ill. Adm. Code 920.50).

H) Filtered Water Pump and Pressure Tank. An electrically driven pump shall be provided to remove water from the storage tank. The water distribution system shall be designed to maintain a minimum positive pressure of 20 pounds per square inch (p.s.i.) in all parts of the system at all times. Water pipe shall conform to applicable specifications and standards of the Illinois Plumbing Code (77 Ill. Adm. Code 890, Section 890.1150) for the type of pipe to be used.

I) Filter Building. A building or structure shall be provided to enclose the filter and pumps. If the system is to be operated through the winter months, heating must be provided to prevent freezing.

c) Cartridge Filtration. The treatment plant shall include the following principal units.

1) Raw Water Pump. The pump shall be driven by an electric motor and be controlled by a pressure switch set to turn on the pump at a pressure of no less than 20 pounds per square inch. The pump shall be protected against excessive cycling by the installation of a hydropneumatic tank. The volume of water that can be drawn from the hydropneumatic tank between pump cycles shall be at least equal to the volume of water pumped in 30 seconds. The hydropneumatic tank shall be installed upstream of the filters and disinfection system.

2) Particulate Reduction Filter. Particulate reduction shall be accomplished using a filter certified to comply with ANSI/NSF Standard 42 − Drinking Water Treatment units − Aesthetic Effects, for particulate reduction, class I or II and be listed as such by an approved certification agency. The design flow rate in the particular application in which the filter is utilized shall not exceed the rated service flow rate for which the filter was certified. An official certification label from the certifying agency shall be permanently affixed to the filter. When treating turbid waters, an additional filter may be needed prior to the particulate reduction filter.

3) Turbidity Reduction and Cyst Reduction. Turbidity reduction and cyst reduction shall be accomplished utilizing either separate filters for each process or one filter for both processes. The turbidity and cyst reduction filters shall be located downstream of the particulate reduction filter.

A) Turbidity Reduction Filter. Turbidity reduction shall be accomplished using a filter certified to comply with ANSI/NSF Standard 53 − Drinking Water Treatment units − Health Effects, for turbidity reduction and be listed as such by an approved certification agency. The design flow rate in the particular application in which the filter is utilized shall not exceed the rated service flow rate for which the filter was certified. An official certification label from the certifying agency shall be permanently affixed to the filter.

B) Cyst Reduction Filter. Cyst reduction shall be accomplished using a filter certified to comply with ANSI/NSF Standard 53 − Drinking Water Treatment units − Health Effects, for cyst reduction and be listed as such by an approved certification agency. The design flow rate in the particular application in which the filter is utilized shall not exceed the rated service flow rate for which the filter was certified. An official certification label from the certifying agency shall be permanently affixed to the filter.

4) Flow Control. A flow control valve and a flow rate meter shall be installed downstream of the filters. The flow rate meter shall have a range which will permit the measurement of the rated service flow rate for the filters, and shall have an accuracy of ± 10% over the full scale.

d) Disinfection.

1) A disinfection system shall be installed with calcium or sodium hypochlorites or gas chlorine or other disinfecting agents approved by the Department. Proposals for the use of disinfecting agents other than those specifically listed in this Section must be approved by the Department prior to preparation of final plans and specifications. The Department will grant approval when all available information establishes that the chemical to be used as a disinfecting agent meets the following conditions: the residual levels created by the use of the chemical will not jeopardize the health of the user of the water, testing procedures for residual elements are recognized in "Standard Methods for the Examination of Water and Wastewater" (1995 Edition − American Public Health Association) (see Section 930.15) and the chemical will destroy bacteria in the water supply. Ultraviolet disinfection may only be used in water treatment plants utilizing cartridge filtration.

2) Chlorination. Disinfection using chlorine shall include feeding equipment, a retention tank and testing equipment.

A) Chlorination Equipment. The chlorinator shall be designed to provide a free chlorine residual of at least two milligrams per liter (mg/l) in the water. The equipment shall be designed so that it will operate accurately over the desired feeding range. Where flow is uniform, actuation of a constant volume feeder by the pump circuit is required. Where flow is variable, automatic flow proportioning is required.

i) Hypochlorinator. Positive displacement pumps shall be provided to inject hypochlorite solution. The pump shall be of variable flow type and shall be of sufficient capacity to feed the required amount of disinfectant. If calcium hypochlorite is used, the concentration of calcium hypochlorite in the solution shall not exceed 5 percent. The solution container shall have a minimum capacity equal to the volume of solution required per day. The chlorine pump shall be controlled by a float switch located in the filtered water storage tank. Chlorine shall be pumped whenever water is flowing into the storage tank.

ii) Gas Chlorinators. Any gas chlorination system shall meet the requirements of Section 900.40(n)(5) of the Drinking Water Systems Code (77 Ill. Adm. Code 900.40(n)(5)).

B) Contact Time and Point of Application. Chlorine shall be applied after the filter and prior to the filtered water storage tank, and in a manner that will provide a free chlorine residual of at least 2 milligrams per liter in the water after thorough mixing and a contact time of at least 30 minutes at maximum flow rates. The pipe carrying water from the filter shall terminate at or above the water surface of the storage tank. Water shall be withdrawn from a solid pipe at a point not more than 3 inches above the bottom of the water storage tank.

C) Testing Equipment. Chlorine residual test equipment capable of measuring free chlorine residual shall be provided and shall be capable of measuring residuals to the nearest 0.1 mg/L in the range below 0.5 mg/L, to the nearest 0.3 mg/L between 0.5 and 1.0 mg/L, and to the nearest 0.5 mg/L between 1.0 mg/L and 2.0 mg/L.

3) Ultraviolet Disinfection. Where ultraviolet disinfection is used, it shall be accomplished using an ultraviolet disinfection system certified to comply with ANSI/NSF Standard 55 − Ultraviolet Microbiological Water Treatment Systems − Class A Systems. The design flow rate for the ultraviolet disinfection equipment shall be at least equal to the rated service flow rate for any of the filters. The ultraviolet disinfection equipment shall be installed downstream of the filters.

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