Chapter NR 111

REQUIREMENTS FOR THE OPERATION AND DESIGN OF PUBLIC WATERWORKS

History: Chapter NR 111 as it existed on November 30, 1974 was repealed and a new Chapter NR 111 was created effective December 1, 1974.

NR 111.01 Applicability. This chapter governs the general operation, design and construction of public water supply systems or waterworks. The standards for design and construction shall be considered minimum standards for new facilities and the standards to which existing facilities shall be upgraded when improvements are undertaken.

Note: The authority to promulgate and enforce these rules is contained in chapters 144 and 162, Wisconsin Statutes. Pursuant to section 144.57, Wisconsin Statutes, any person who violates this chapter shall forfeit not less than $10 nor more than $5,000 for each violation. Each day of continued violation is a separate offense.

History: Cr. Register, November, 1974, No. 227, eff. 12-1-74.

NR 111.02 Severability. Should any section, paragraph, phrase, sentence, clause or word of this chapter be declared invalid or uncon-

stitutional for any reason, the remainder of this chapter shall not be affected thereby.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

NR 111.03 Definitions. The definitions in this section shall apply whenever the listed terms are used in this chapter.

(1) "Approval" means the written approval of the department for any project requiring approval pursuant to section 144.04, Wis. Stats., and NR 108.03, Wis. Adm. Code.

(2) "Department" means the department of natural resources.

(3) "Distribution system" means all pipes or conduits by which water is delivered to consumers except piping inside buildings served and service pipes from a building to a distribution main or pipe.

(4) "Cross connection" means any physical connection or arrangement which may result in a flow between a potable water supply piping system and a piping system conveying water which is unsafe or likely to become unsafe, or steam, gas or chemical.

(5) "Ground water" means that part of the subsurface water which is in the zone of saturation.

(6) "Ground water source" means all ground water obtained from horizontal collectors, infiltration lines, and dug, drilled or other types of wells and springs.

(7) "Operator" means the individual, designated to the department by the owner or his authorized representative, who is in direct charge of operation of a waterworks.

(8) "Owner" means the state, county, town, town sanitary district, city, village, firm, company, institution, association, utility district, or individual owning or operating a public water supply system.

(9) "Public water supply system" means a facility serving a county, town, town sanitary district, city, village, institution, utility district, jointly owned systems or privately owned utilities serving ten or more premises of mixed ownership. Institution as applied to these rules is a public institution as defined in section 49.10 (12) (f) 1., Wis. Stats.

(10) "Reviewable project" shall have the same meaning as set forth in NR 108.02 (6).

(11) "Utility" means a public utility as defined in chapter 196, Wis. Stats.

(12) "Waterworks or water system" means any facility installed or constructed to obtain, store, treat or convey water for drinking or domestic use for a public water supply.

(13) "Well" means an excavation or opening into the ground made by digging, boring, drilling, driving or other methods for the purpose of obtaining ground water.

(14) "Well driller" means a person defined as a well driller by section 162.02 (5), Wis. Stats.

(15) Abbreviations. The following abbreviations are used in this chapter:

(a) The term "A.P.I." means the American Petroleum Institute, 300 Corrigan Tower Building, Dallas, Texas 72501.

(b) The term "A.S.T.M." means the American Society for Testing and Material, 1916 Race Street, Philadelphia, Pennsylvania 19103.

(c) The term "A.W.W.A." means the American Water Works Association, 6666 West Quincy Avenue, Denver, Colorado 80235.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

NR 111.04 Alternative requirements. (1) If the owner of a proposed reviewable project feels that compliance with the design requirements of the chapter is impracticable, the reasons therefore shall be fully communicated in writing to the department prior to submission of final plans. This communication must set forth alternative requirements for which department approval is sought and all pertinent facts, data, reports and studies supporting the imposition of such alternative requirements.

(2) If the department determines that compliance with the design requirements of this chapter would be impracticable in specific cases, it may approve alternative requirements which, in its opinion, are in substantial compliance with the requirements of this chapter.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

PART 1. SUBMISSION AND APPROVAL OF PLANS AND SPECIFICATIONS

NR 111.10 General requirement. Plans and specifications for all reviewable projects must be submitted in accordance with the rules in chapter NR 108. Plans shall comply with or incorporate the general design and operating requirements set forth in that chapter.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

NR 111.11 Specific requirements for waterworks, plans, specifications and engineering report. (1) PLANS. (a) *General.* The detailed construction plans shall contain appropriate plan views, elevations (sea level datum), sections and supplemental views which together with the specifications provide all necessary information for construction of the improvements. Manufacturers drawings are not acceptable as construction plans and will not be approved.

Note: Applicable state and local codes, including those of the department of industry, labor and human relations, the public service commission and the department of health and social services, should be consulted for other requirements.

(b) *Wells.* The general plan shall show the location of the proposed well and its relation to proposed or existing facilities. It shall show all features of sanitary significance which could have an effect on water quality. A site plan shall be submitted which shows the property lines, contours (or an appropriate number of spot elevations) so that drainage can be determined, surficial features, structures and any other relevant data. The detailed well plan shall show the size and depths of drill holes and casings, depth of grout, and geological formations to be penetrated.

Note: A scale of 1 inch to 10 or 20 feet is recommended.

(c) *Surface water intakes.* 1. Location plan. Plans shall show the location of the intake pipeline and crib relative to the low lift pumping facility. The pipeline shall be referenced by bearing and distance, and the crib location shall be defined by latitude and longitude.

2. Detailed Plans. A profile of the proposed pipeline and crib shall be provided in addition to construction plans.

(d) *Treatment plants.* 1. Location Plan. The location plan shall show the location of the treatment plant in relation to the remainder of the system and the water source or intake.

2. Layout. The general layout plan(s) shall include a contour map of the site, the site size, the size and location of plant structures, a

schematic flow diagram indicating the various plant units, the piping layout, and a hydraulic profile at gravity plants.

3. Detailed plans. The detailed construction plans shall include the location, dimensions, elevations and details of all existing and proposed plant units or equipment.

(e) *Chemical feed equipment.* The plan shall include a layout of the waterworks structure and piping. The following locations and details of the proposed equipment shall be included:

1. Descriptions of feed equipment, including maximum feed ranges;
2. Location of feeders, piping layout and points of application;
3. Storage and handling facilities;
4. Specifications for chemicals to be used;
5. Operating and control procedures;
6. Description of testing equipment and procedures;
7. Well or booster pump discharge rates and pressures.

(f) *Pumping facilities.* The plan shall show a general layout of the pumping equipment, the suction and discharge lines and related housing and appurtenances.

(g) *Water mains.* 1. Location plan. The plan shall show the proposed water main extensions in relation to existing facilities. A map, such as required by NR 111.28 (3), of the existing system or a portion thereof with the proposed extensions shown will satisfy this requirement.

2. Detailed plans. The plans shall show the location of the proposed water main within the street right-of-way or easement; the location of other utilities, such as, sanitary or storm sewers; elevations at intersections and hydrants or a profile of the proposed water main; location of proposed appurtenances; details or special features and connection to the existing system. Profiles showing the ground surface, the proposed water main, the proposed sanitary sewer and rock depths are necessary when approval of a common trench is requested in high bedrock areas. The size of proposed and existing water mains shall also be shown.

(h) *Storage facilities.* 1. Location plan. The plan shall show the location of the proposed facility in relation to existing facilities.

2. Detailed plans. Plans shall show contour lines at the site and complete construction details.

(2) SPECIFICATIONS. Complete, detailed material and construction specifications shall be supplied for all phases of the proposed project. They shall contain a program for keeping existing waterworks facilities in operation during construction of additional facilities so as to minimize interruptions of service.

(3) ENGINEERING REPORT. The engineering report, required by NR 108.04 (2) (d), shall contain in form for convenient and permanent reference, the controlling assumptions made and the factors used in the functional design of the waterworks facility as a whole and of each of the component units. Where applicable, the report shall make reference to available regional, metropolitan, county or local water supply or water quality management plans and shall clearly indicate whether the proposed project is in conformance with such plans. The report shall, in all cases, indicate the basis of design and shall include the following specific data, if applicable:

(a) *Description.* A brief description of the project and the need for improvements.

(b) *Location.* A description of the geographic location of the project, including reference to maps or exhibits and the location of existing facilities.

(c) *Topography.* A brief description of the topography of the general area and its relation to the area involved in the project.

(d) *Population.* Past census data and estimated future projection to the design year for the area involved in the project.

(e) *Design period.* The design period being used for sizing major system components, based on the population projection.

(f) *Investigations.* The results of any investigations, such as, soil borings, test wells, pilot tests and fire flow tests.

(g) *Flooding.* Any areas of the project which are located within the floodway or floodplain as defined in chapter NR 116. All projects must conform to the requirements of that chapter.

(h) *Recommendations.* After discussion of alternatives, a statement of the reasons for selection of the recommended alternative. Also included shall be a discussion of estimated capital costs, estimated annual operation and maintenance costs.

(i) *Ground water sources.* 1. Site. Describe the sites considered; advantages and disadvantages of site selected and any possible sources of contamination.

2. Investigations. Summarize information on the test well drilling, including the test well location and construction; water quality; pumping conditions and borings and seismic, resistivity or other ground water investigations.

3. Basis of design. Discuss the type of well proposed; the aquifer to be utilized; the desired well capacity; the anticipated annual volume of water to be withdrawn and the compatability with the existing facilities.

(j) *Surface water sources.* To assess the water available at the source, a survey and study shall be made and shall include obtaining samples from a number of locations and depths in order to select the best intake site. Sampling shall be sufficient to adequately determine the characteristics of the water. The report shall summarize information on hydrological data, such as, safe yield; maximum and minimum water levels or flows, and the quality of raw water with special emphasis on results of testing programs, fluctuation in quality and future potential sources of contamination.

(k) *Water treatment or chemical addition processes.* A summary establishing the adequacy of the proposed processes for the treatment of the specific water under consideration. Include any data from pilot or full scale plant studies and describe the method of disposal of any wastes and any possible effects on the environment.

(l) *Pumping facilities.* A description of the area to be served and the basis for design, including maximum and minimum discharge heads and flows and provisions for emergency operation, shall be included.

(m) *Water mains.* 1. Extent. A brief description of the extent of the existing and proposed water mains with reference to an overall system plan. Include any proposals for future extensions or reinforcement.

2. Soil conditions. A description of the character of the soil through

which water mains are to be laid, indicating the approximate elevations of the ground water.

3. Basis of design. Include domestic and fire flow requirements and calculations which indicate the quantity and pressure of water that will be available at critical points.

(n) *Water storage facilities.* A discussion of the static pressure which the proposed facility will provide for existing and future service areas and the domestic and fire storage required within the design period. Explain how the proposed and existing facilities will meet these requirements. Also, relate the compatability of the proposed facilities with existing facilities and any changes that will have to be made to the existing facilities.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

NR 111.12 Owner approval requirement. If the engineer is not an employee or otherwise retained by the owner of the water system, written acceptance of the final plans by the owner is required at the time of submission of the plans to the department.

Note: An example would be where an engineer is retained by a developer to design water main extensions which will be connected to a municipal system and eventually be owned by the municipality. The plans shall be accepted by the municipality before the department issues an approval.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

PART 2. GENERAL REQUIREMENTS FOR SAMPLING, REPORTING AND OPERATION

NR 111.20 General. The owner of the waterworks shall be responsible for insuring that the water system is operated in accordance with this chapter to provide an adequate quantity of safe drinking water to consumers. This responsibility includes performing maintenance and replacement of equipment when necessary to keep the facility in good operating condition as well as providing adequate laboratory testing equipment to control and monitor treatment processes and chemical addition programs.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

NR 111.21 Required sampling and testing. To determine that drinking water standards are met, the following minimum sampling, testing and surveillance requirements shall be complied with:

(1) BACTERIOLOGICAL SAMPLING. (a) All waterworks owners shall submit samples of water to the state laboratory of hygiene each month for bacteriological analysis. The minimum number of samples per month from the distribution system shall be based on the population served by the waterworks as prescribed in Table 1. In no case shall the number of samples required be less than 2 per month. This sampling requirement shall be the same for those water systems that obtain water from another system which also maintains a sampling program.

Note: A laboratory certified by the state laboratory of hygiene may be utilized providing a procedure is approved by the department whereby, 1) unsafe analyses and resamplings are immediately reported to the district office of the department, and 2) safe analyses are submitted to the district office of the department within the time prescribed in NR 108.06 (4).

(b) The water samples shall be obtained from geographically representative locations in order to reveal the presence of any contaminants in the supply of water or from extraneous sources in the distribution system and shall be taken on dates evenly spaced during the month. All unsafe samples shall be resampled immediately. The number of samples included in resampling shall be in addition to the minimum sampling requirement.

TABLE 1

POPULATION LIMITS FOR MINIMUM NUMBER OF BACTERIOLOGICAL SAMPLES PER MONTH

Maximum Population Served	Minimum Samples per Month
2500	2
3300	3
4100	4
4900	5
5800	6
6700	7
7600	8
8500	9
9400	10
10300	11
11100	12
12000	13
12900	14
13700	15
14600	16
15500	17
16300	18
17200	19
18100	20
18900	21
19800	22
20700	23
21500	24
22300	25
23200	26
24000	27
24900	28
26000	29
Numbers taken to nearest 100	

Maximum Population Served	Minimum Samples per Month
28000	30
33000	35
37000	40
41000	45
46000	50
50000	55
54000	60
59000	65
64000	70
70000	75
76000	80
83000	85
90000	90
96000	95
111000	100
Numbers taken to nearest 1000	

Maximum Population Served	Minimum Samples per Month
130,000	110
160,000	120
190,000	130
220,000	140
250,000	150
290,000	160
320,000	170
360,000	180
410,000	190
450,000	200
500,000	210
550,000	220
600,000	230
660,000	240
720,000	250
780,000	260
840,000	270
910,000	280
970,000	290
1,050,000	300
Numbers taken to nearest 10,000	

Note: Population served shall be based on the most recent 10-year U.S. Census population unless more recent data is available.

(c) In addition to sampling from the distribution system, each owner of a well system providing chlorination shall obtain at least one sample every 3 months from each well prior to any chemical addition. For waterworks which have more than 2 wells in the same location and utilizing the same aquifer, only one of the wells needs to be sampled each time on an alternating basis. If a well has a high potential for contamination, the department may in individual cases require more frequent sampling.

(d) At surface water facilities, the bacteriological quality of the water shall be monitored often enough to maintain quality control of the treatment process. Each plant shall establish a schedule which will be subject to review and modification by the department.

Note: Generally, membrane filter or 5 tube fermentation tests and plate counts of the raw, settled and finished water on an established schedule will be necessary to meet this requirement.

(e) At all waterworks which have a potential for high total bacteria levels because of the water quality, the method of treatment, chemical addition or other cause, the department shall require plate counts pursuant to an established schedule.

(2) CHEMICAL SAMPLING. (a) *Fluoride.* 1. The owner of a waterworks artificially fluoridating the water shall establish a monitoring program in order to maintain a fluoride concentration which does not exceed the drinking water standards in NR 111.22 (2).

Note: The dental health section of the department of health and social services recommends that the fluoride concentration be maintained within the range of 1.0 to 1.5 mg/1 for optimum dental benefits.

2. The monitoring program shall include:

a. Submission of the results of fluoride tests of samples from the distribution system taken at least once per day, and

b. One sample per month taken from a representative location in the distribution system and submitted to the state laboratory of hygiene.

Note: For waterworks with large distribution systems and multiple sources, more than one fluoride test per day may be necessary to assure proper feed rates. See NR 111.55 (5) for testing equipment requirements. Exceptions to the daily fluoride test requirement may be approved by the department if it is demonstrated that the optimum fluoride concentration in subsection (1) above will be maintained by a reduced monitoring program.

3. The sample submitted to the state laboratory of hygiene shall be a portion of a split sample so that the operator can determine the fluoride concentration with his equipment and compare it to the state laboratory results. The fluoride concentration obtained by the operator shall be noted on the data sheet prior to submission to the state laboratory.

(b) *Chlorine.* The owners of all waterworks which chlorinate water shall test chlorine residuals at locations and intervals necessary to control the chlorination process. At ground water supplies, the chlorine residual of a sample from a representative location in the distribution system shall be checked at least twice per week. Waterworks having surface water treatment plants shall determine the chlorine residual in the plant effluent at least every 2 hours and in the distribution system at least daily in representative locations. Where water quality changes rapidly, residuals shall be tested at more frequent intervals as specified by the department. Also, in those

individual cases, continuous monitoring equipment may be required if necessary to protect public health.

Note: Chlorine residual testing is recommended when bacteriological samples are taken; results should be included on the sample slip.

(c) *Other chemicals.* Testing for other chemical constituents shall be performed at waterworks if the department determines it to be necessary for water quality control and gives reasonable notification to the owner of this fact.

(3) PHYSICAL TESTING. All waterworks shall perform any physical analyses necessary to determine whether the physical standards in NR 111.22 are complied with by the waterworks. Waterworks served by ground water may be exempted from this requirement on a case-by-case basis after a showing that the testing is unnecessary to assure compliance with such standards.

(4) OTHER SAMPLING. If necessary to determine the quality of water being distributed to consumers, the waterworks owner may be required to analyze samples or to submit samples to the department for any analysis deemed necessary.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

NR 111.22 Drinking water standards. Water must be tested to insure that the drinking water standards contained in this section are met. Testing methods shall be in accordance with the 13th edition of *Standard Methods for the Examination of Water and Wastewater* (1971) or other methods specifically approved by the department. A copy of this publication is available for inspection at the office of the department of natural resources, the secretary of state's office and the office of the revisor of statutes and may be obtained for personal use from the American Public Health Association, 1015 Eighteenth St., N. W., Washington, D. C.

(1) BACTERIOLOGICAL STANDARDS. The following standards are based on the U. S. environmental protection agency drinking water standards with the exception of the bacteriological standards which are more stringent:

(a) An unsafe sample is considered to be one or more positive tubes by the five tube method (5 portions of either 10 or 100 ml) or a mean coliform count of 1 or greater per 100 ml by the membrane filter method.

(b) Bacterial plate counts on water distributed to the consumer shall not exceed 500 organisms per (1) milliliter. When this value is exceeded the department shall determine if the bacterial count is of public health or nuisance significance and require appropriate action.

(2) CHEMICAL AND PHYSICAL. The various chemical substances that may be contained in the water and properties of the water furnished to the consumers have been placed into 2 categories based on physiological hazards or aesthetic conditions as determined from the best available information.

(a) *Health limits.* Water containing substances above these limits presents a risk to the health of consumers and may not be used for drinking or culinary purposes, except as approved by the department.

(b) *Aesthetic limits.* Water containing substances above these limits is not hazardous to health but may be objectionable to an

appreciable number of persons and some form of remedial action may be required to insure that consumers receive the highest quality water practicably obtainable.

Standard—mg/1 except as noted	*Type of Limit*
Arsenic—0.1	Health
Barium—1.0	Health
Cadmium—0.01	Health
Chloride—250	Aesthetics
Chromium—0.05	Health
Color—15 units	Aesthetics
Copper—1	Aesthetics
Cyanide—0.2	Health
Fluoride—2.4	Health[1]
Foaming agents	
MBAS (Methylene-Blue Active Substances)—0.5	Aesthetics
Iron—0.3	Aesthetics
Lead—0.05	Health
Manganese—0.05	Aesthetics
Mercury—0.002	Health
Nitrate—10.0 as (N)	Health
Odor—3 (Threshold No.)	Aesthetics
Organics—Carbon Adsorbable	
CCE_m (Carbon Chloroform Extract)—0.7	Health[2]
CAE_m (Carbon Alcohol Extract)—3.0	Health

[1] Natural fluoride concentrations exceeding 2.4 mg/1 may be allowed in water if dental fluorosis is not a significant factor.
[2] The subscript "m" denotes determination by miniaturized sampler and extraction technique.

Pesticides—all health limits

A) Chlorinated Hydrocarbon Insecticides

Aldrin—0.001	Heptachlor—0.001
Chlordane—0.003	Heptachlor Epoxide—0.0001
DDT—0.05	Lindane—0.005
Dieldrin—0.001	Methoxychlor—0.1
Endrin—0.0005	Toxaphene—0.005

B) Organophosphate Insecticides

0.1 mg/1 of Parathion or total concentration of organophosphate insecticide producing inhibition of acetyl chlorinesterase no greater than the inhibition produced by 0.1 mg/1 of Parathion.

C) Chlorophenoxy Herbicides

2,4-D—0.02
2,4,5-TP—0.03

Selenium—0.01	Health
Silver—0.05	Health
Sodium	No limit designated[3]
Sulfate—250	Aesthetics
Turbidity—1 TU	Health[4]
Zinc—5	Aesthetics

[3] The waterworks owner should periodically notify local physicians of the sodium content of the water supply in order that the physicians may advise their patients of suitable dietary restrictions.

[4] Turbidity shall not exceed 1 unit except where it can be demonstrated that a higher turbidity not exceeding 5 units does not interfere with disinfection, cause tastes and odors upon disinfection, prevent the maintenance of an effective disinfection agent throughout the distribution system, result in deposits in the distribution system and cause consumers to question the safety of their drinking water.

(3) RAW SURFACE WATER. The intake water shall be the highest quality reasonably available and which, with appropriate treatment and adequate safeguards, will meet the drinking water standards in this subsection.

Note: For guidelines, see NR 102.

(4) RADIOLOGICAL QUALITY.

Note: Limits are being evaluated by the U. S. environmental protection agency. The department recommends that it be contacted for advice on a case-by-case basis until national standards are available for inclusion in these rules.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

NR 111.23 General treatment and disinfection requirements. Treatment shall be provided by each waterworks owner in order to insure that the water meets the drinking water standards and is not offensive or hazardous to consumers. In addition, the following requirements must be met:

(1) SURFACE WATER TREATMENT. (a) All public water supply systems drawing water from lakes, rivers, streams or other surface water sources shall treat the water as provided in this chapter. In general, this treatment shall include disinfection, coagulation, sedimentation and filtration. All deviations from required treatment methods must be approved by the department and based on data which shows that the requirements of this chapter are unnecessary in the specific case.

(b) The effluent discharged from a surface water treatment plant shall contain sufficient chlorine to maintain a free chlorine residual of at least 0.1 mg/1 throughout the distribution system or, if chloramines are present, the combined residual throughout the distribution system shall be a minimum of 0.5 mg/1.

Note: Design and construction requirements are contained in Part 4 of this chapter, NR 111.40 and following.

(2) GROUND WATER TREATMENT. (a) The department may require continuous chlorination of ground water sources if water quality data or well or system construction indicate a potential health hazard. Chlorination of ground water is to supplement and not replace proper well location, construction and source protection. When chlorination of a ground water source is required for health reasons, the residual maintained in the distribution system shall be the same as that for surface water.

(b) Ground water sources most susceptible to contamination, such as springs, shallow wells, and wells developed in limestone which are not overlain with sufficient protective material, shall be chlorinated and an adequate detention period provided before the water reaches the consumers. Chlorination of ground water shall be required in facilities which expose the water to the atmosphere, such as open basins, filters or gravity aerators.

(c) If a ground water source is contaminated, it shall be removed from service and reconstructed or abandoned. Under emergency conditions the department may permit temporary use of a bacterio-

logically contaminated ground water source if chlorination adequate to insure safe water is provided. Such use shall be terminated when the source is replaced or reconstructed.

Note: See Part 3 of this chapter, NR 111.30 and following, for design and construction requirements.

(3) CONSTRUCTION AND MODIFICATIONS. (a) After construction, repair or modification, waterworks facilities shall be disinfected by procedures outlined in A.W.W.A. Standard A100 (1–7), (January 23, 1966), C601, (June 2, 1968) or D102 (5) (1964). In addition, they shall not be placed in service until bacteriological samples have established that the water is safe for consumption. Copies of the above standards are available for inspection at the office of the department of natural resources, the secretary of state's office and the office of the revisor of statutes, and may be obtained for personal use from the American Water Works Association, 6666 West Quincy Ave., Denver, Colorado, 80235.

(b) At least one bacteriologically safe sample shall be obtained before facilities are placed into service. In the case of wells, a minimum of 2 bacteriological safe samples, taken at least 8 hours apart during the test pumping period, shall be obtained. When new systems or extensions on a number of streets are installed, bacteriological samples shall be taken to establish that the improvements are free of contamination. For water storage facilities, 2 or more successive safe samples, taken at 24-hour intervals, shall be obtained which indicate bacteriologically safe water. One safe sample will be sufficient only if a free chlorine residual of at least 0.1 mg/1 is remaining when the results of the safe sample are reported.

(4) CHEMICAL TREATMENT. (a) All waterworks shall be equipped with chemical feed equipment and the necessary appurtenances which can continuously disinfect the water.

(b) All surface water treatment plants and other waterworks where treatment is required shall be equipped with backup chemical feed equipment in the event of failure of the primary equipment.

(c) Approval from the department is required for the addition of any chemical to a public water supply. A 30-day supply of chemicals shall be kept on hand as required by NR 108.06 (3). Chemicals shall meet current A.W.W.A. standards and be approved by the department. Colored chemicals will be approved if not used in toxic concentrations or in amounts which impart taste, odor or color to the water supply. The department may require the assay of chemicals if necessary to insure safe use of chemicals. Copies of the above standards are available for inspection at the office of the department of natural resources, the secretary of state's office and the office of the revisor of statutes, and may be obtained for personal use from the American Water Works Association, 6666 West Quincy Ave., Denver, Colorado, 80235.

Note: The chemical standards referred to in (4) (c) are those issues in effect at the effective date of NR 111.

(d) Chemical containers shall be labelled to include the chemical name, purity, concentration and name and address of the supplier.

(e) Requests for the substitution of disinfection agents in lieu of chlorine for bacteriological control may be approved by the depart-

ment. However, such agents may not be used without specific approval by the department.

Note: Refer to Part 5 of this chapter, NR 111.50 and following, for requirements for design and construction of facilities for storage handling, and chemical application.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

NR 111.24 Distribution systems. (1) OWNERSHIP. The distribution system, as defined in NR 111.03, shall be owned and maintained by the waterworks owner. All water mains on private property which are, or in the future may be, connected to the distribution system at more than one point, thereby allowing flow through the piping system, shall be owned and maintained by the waterworks owner.

Note: To insure the use of approved materials and the proper installation and maintenance, the department recommends that proposed fire hydrants and water mains serving fire hydrants on private property be installed in easements and owned and maintained by the waterworks owner.

(2) NORMAL PRESSURE. The distribution system and related storage facilities shall be operated to maintain a minimum of 35 pounds per square inch at all locations under normal operating conditions. In areas where this pressure cannot be maintained, it shall be necessary to proceed as required in NR 111.64 (1).

(3) FIRE FLOW PRESSURE. The system shall be operated so that under fire flow conditions the residual pressure is not less than 20 pounds per square inch (gauge). If 20 psi cannot be maintained, fire pumpers shall not be allowed to connect to fire hydrants.

(4) MAINTENANCE. Each waterworks owner shall establish a schedule for flushing dead-end mains or mains in other areas to remove sediment or objectionable water. Water storage facilities shall be inspected on a routine basis and maintenance provided as necessary. Record keeping shall be established to insure routine scheduling and performance of valve and hydrant maintenance.

Note: Requirements for the design and construction of distribution systems are contained in Part 7 of this chapter, NR 111.70 and following.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

NR 111.25 Cross-connections and interconnections. Physical connection between a public water supply system and any other source of water or potential source of contamination which would allow water or other liquids or gas from these sources to be pumped or drawn into the public system are prohibited except as provided in subsections (2) and (3) below.

(1) CROSS-CONNECTION CONTROL PROGRAM. Each waterworks owner shall develop and implement a comprehensive control program for the elimination of all existing cross-connections and prevention of all future cross-connections. A record of the cross-connection control program shall be kept current and available for annual review by the department. The program plan shall include but not be limited to:

(a) A complete description of the program and the administration procedures, including designation of the inspection or enforcement agency or agencies;

(b) Local authority for implementation of the program, such as, ordinance or rule;

(c) A time schedule for inspection and reinspection of all con-

sumer premises for cross-connections including appropriate record keeping;

(d) A description of the methods and devices which will be used to protect the water supply by reference to or inclusion of chapter H62, Wisconsin Administrative Code;

(e) Provisions for denial or discontinuance of water service, after reasonable notice, to any premises where an unprotected cross-connection exists.

(2) FIRE PROTECTION SYSTEMS. (a) An existing cross-connection for fire protection purposes only, which was originally approved and installed before January, 1924, may be continued if:

1. The need for the cross-connection can be demonstrated to the department, and

2. The double check valve installations are replaced with an approved reduced pressure backflow device and an approved installation no later than 5 years from the date of adoption of these rules. Double check valves in need of replacement prior to that date shall be replaced with an approved backflow preventor installation at that earlier date. All devices shall meet the requirements of chapter H62, Wisconsin Administrative Code.

(b) Each double check valve installation shall contain suitable gauges and drains for testing as shown in Fig. 1. Monthly inspections of the equipment shall be made and reported to the department by the owner of the public water supply by the tenth day of each month as provided in NR 108.06 (4). The department reserves the right to require the elimination of any fire protection cross-connection if inspections are not regularly made and reported or if the installation is no longer necessary or found faulty. Once a cross-connection has been removed, it shall not be reinstalled.

(3) INTERCONNECTIONS WITH OTHER WATER SOURCES. Interconnections between the public water supply system and another source of water which is of acceptable quality may be permitted in individual cases. Approval of the department shall be obtained prior to the interconnection.

(4) WASTEWATER TREATMENT PLANTS. Protection for the public water supply shall be provided as outlined in NR 110.09 (16).

Note: See Part 7 of this chapter, NR 111.70 and following, for design and construction of distribution systems.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

NR 111.26 Abandonment of wells. (1) PERMANENT ABANDONMENT METHODS. When a well is permanently abandoned, the owner thereof shall fill and seal the well, to prevent it from acting as a channel for contamination or vertical movement of water, by the following applicable method:

(a) *Drift or other unconsolidated formation wells.* A 20-foot concrete plug shall be poured at the top of the well with the remainder filled with concrete or clean puddled clay. Inner ungrouted well casing with screen shall be removed from gravel-pack wells prior to filling.

(b) *Limestone formation wells.* Fill any limestone strata entirely with concrete or, as an alternative, with layers of concrete and gravel or stone aggregate, provided that the top 20 feet of the rock formation and the entire cased portion of the well are filled with concrete.

Exception to filling the cased portion with concrete under the alternative method may be made where the well casing is set in rock and sealed in place with cement grout; in such case a concrete plug at least 40 feet thick shall be placed extending at least 20 feet above and below the bottom of the casing. The remainder of the cased portion up to 20 feet from the surface may be filled with gravel, crushed rock, sand or clay, but the top 20 feet shall be filled with concrete.

(c) *Sandstone formation wells.* Fill any sandstone formations entirely with concrete or, as an alternative, with disinfected sand or pea gravel, provided that the top 20 feet of the formation and the entire cased portion in this alternate method are filled with concrete. The exception to entirely filling the casing with concrete in paragraph (b) above is applicable here.

(d) *Shale, granite and quartzite formation wells.* (Use procedure for limestone formation well in paragraph (b) above.)

(e) *Mixed formation wells.* Fill limestone, sandstone, shale, granite and quartzite strata as provided in paragraph (b), and provide concrete or concrete grout plugs at least 40 feet in depth, extending at least 20 feet above and below the point of surface contact between every distinct geologic formation where the alternative methods to filling the well entirely with concrete are selected.

(f) *Flowing wells.* Confine flow and fill wells in accordance with paragraph (b) procedures or seal with cement grout applied by a pressure method approved by the department.

(g) *Obstructions.* Any debris or obstructions that may interfere with sealing operations shall be removed from the well prior to abandonment.

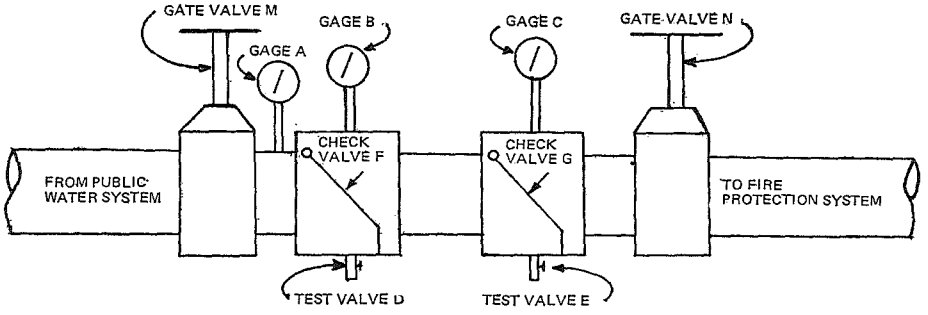
(h) *Procedural limitations.* Filling material for nonflowing wells shall be applied through a conductor pipe unless a dump bailer is used. When concrete is placed under water by a conductor pipe, the bottom end of the conductor pipe shall be submerged in the concrete at all times. Pump piping and removable liner pipes shall be pulled from a well prior to sealing.

(2) TEMPORARY ABANDONMENT. When a well is temporarily removed from service, the top shall be sealed with a water-tight threaded or welded cap or be filled with clean puddled clay. After 5 years of temporary abandonment, a well shal be permanently abandoned and sealed in accordance with subsection (1) above. Approval of the department shall be obtained for any deviations from this requirement.

(3) REPORT TO DEPARTMENT. A report shall be made to the department by the owner within 30 days after a well has been permanently abandoned or temporarily removed from service. Such report shall include a detailed description of location, construction and geologic features, and method of sealing. The report must be on forms supplied by the department.

(4) PRIVATE WELLS. In addition to the requirements for abandonment of public water supply wells, owners of waterworks shall require the abandonment of all unused, unsafe or noncomplying private wells located on premises served by their system. Such abandonment is required to prevent the well from acting as a channel for contamina-

TESTING PROCEDURE FOR DOUBLE CHECK VALVES FIGURE NO. 1



TESTING PROCEDURE

Step 1: Close gate valve M. Turn on fire pump if not on continuously.

Step 2: Read Gages A, B and C and record original pressures.

Step 3: Open test valve D and read Gages A, B and C and record. If pressure falls to zero at Gage A and holds at B after slight decrease, check valve F is tight. Wait 10 minutes and record Gage B again before proceeding with Step 4. Also, note if leakage occurs from drain D.

Step 4: Open test valve E leaving test valve D open. Read Gage B to determine if it falls to zero and record. Also, record reading at Gage C. If Gage B reads zero and flow from drain E ceases, check valve G is tight.

Step 5: Restore facilities to normal operation if no leakage is indicated. If either check valve leaks, close gate valve N and keep both gate valves closed until the check valves have been repaired. The district office of the department should be notified immediately if either check valve is leaking.

tion or vertical movement of water. Implementation shall be by local ordinance or water department rule.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

NR 111.27 Other requirements. (1) AUTHORIZATION FOR OPERATION OF NEW SYSTEMS. Before a new public water system can be placed into service, written authorization of the department shall be obtained. To obtain authorization the owner shall meet the following requirements:

(a) An inspection of the facilities shall be made by a representative of the department to determine if construction is in accordance with the approved plans and specifications. Deficiencies shall be corrected prior to startup.

(b) The department shall be informed in writing of the name of the certified waterworks operator who will be in charge of the water system.

Note: See NR 108.06 (2) and chapter NR 114 for certified operator requirements.

(c) A copy of an ordinance requiring the abandonment of all unused, unsafe or noncomplying private wells shall be required of the governing body having jurisdiction. The ordinance shall contain the following:

1. A requirement that all private water supply well or pump installations which will not be used currently, or are found to be in noncompliance with chapter NR 112, or wells which test unsafe, shall be abandoned in accordance with NR 112 by an established date which should not extend beyond one year from date of connection to the public system.

2. Provisions that allow retention of private water supply systems which are found to be in compliance with NR 112 with the limitation that the owner must demonstrate a need for continued current use.

(d) A copy of an ordinance establishing a cross-connection control program as described in NR 111.25 shall be submitted to the department.

(e) Bacteriological sampling, as required by NR 111.23 (3), shall be completed to establish that the water is safe for consumption.

(2) REPORTS. All waterworks owners shall submit monthly reports on forms supplied by the department to the appropriate district office of the department as required by NR 108.06 (4). Reports shall include the following data if applicable:

(a) Daily quantities of water pumped;

(b) Daily quantities of chemicals added to the water;

(c) Daily operation of treatment processes;

(d) Results of chemical, physical or any other tests performed for plant control;

(e) Ground water depth measurements (static and pumping) at least weekly where applicable;

(f) Totals and averages of the above where spaces are provided on the report form;

(g) Other data determined necessary by the department.

(3) MAPS. Each waterworks owner shall keep current a map of the system which shows the size and location of all facilities and appurtenances, such as, water mains, valves, hydrants, wells or

sources, pumping stations, treatment plants and storage facilities. Contour lines or ground elevations at intersections shall be shown as well as the overflow elevations of the system storage units. Any pressure zones shall be delineated. Two current copies of this map shall be kept on file with the department at all times.

Note: Use of standard symbols as shown in A.W.W.A. M8 Distribution Manual is recommended. This manual is available for inspection at the office of the department of natural resources, the secretary of state's office and the office of the revisor of statutes, and may be obtained for personal use from the American Water Works Association, 6666 West Quincy Ave., Denver, Colorado, 80235.

(4) CERTIFIED OPERATOR. All waterworks owners shall comply with the certified operator requirements in NR 108.06 (2) and NR 114.

(5) AUXILIARY POWER. Each waterworks owner shall insure that minimal service is provided during emergencies resulting from failure of power supply, fire, storm, or similar emergency.

(6) METERS. Each waterworks owner shall provide a means of accurately measuring the daily quantity of water pumped or delivered.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

PART 3. GROUND WATER—REQUIREMENTS FOR DESIGN AND CONSTRUCTION OF FACILITIES

NR 111.30 Wells. (1) GENERAL REQUIREMENTS. (a) All wells shall be terminated above the ground surface and the pump discharge piping shall be exposed above the ground surface within a building or enclosure.

(b) All wells shall have watertight construction to such depth as may be required to exclude contamination. This shall be below the pumping water level except where exempted by the department on a case-by-case basis when it is shown that the other requirements of this chapter will be met.

(c) The protective casing of all wells shall be surrounded with a minimum of 1.5 inches of neat cement or concrete grout to the depths indicated in NR 111.31 and NR 111.32. A minimum of 5 feet of grout shall be in contact with the native geologic formation.

(d) Water used in drilling operations shall not be from a source that will contaminate an aquifer. A chlorine residual shall be maintained in the well during drilling operations.

(e) Test holes to determine geologic formations and water quality and quantity data shall be drilled for wells proposed in unconsolidated formations.

Note: In certain areas where geologic data for consolidated formations is not available, test holes may be required by the department.

(f) Flowing wells shall be provided with valving to control the flow and to prevent the erosion of the confining bed; every practicable effort shall be made to install the grouted casing below the confining bed.

(g) Materials used as drilling aids, such as drilling muds and foam or other aids shall be compounds approved by the department.

(2) WELL DRILLER REQUIREMENTS. All wells shall be constructed by a driller registered in Wisconsin (see section 162.04, Wis. Stats.). A Wisconsin Well Constructor's Report shall be forwarded to the

department and the owner by the driller immediately upon completion of the well.

(3) INTERFERENCE BETWEEN UTILITY WELLS. When the department determines that a proposed well may have a substantial effect on the water levels in one or more wells owned by another water utility, the following procedure shall be followed:

(a) The department shall provide the owners of utility wells which may be affected by the proposed well with information on its location, proposed constructional features and the anticipated volume of water to be withdrawn.

(b) If the owner of another utility well wishes to object to the proposed utility well, he shall inform the department in writing of the reasons for his objection within 30 days of receipt of the information described in (a).

(c) If notice of objection is filed and good cause is shown, the department will hold a public hearing at which all interested parties may present testimony to be used by the department in determining if a restriction shall be placed on the volume of water withdrawn from the proposed well or existing utility wells or if approval for the proposed well shall be denied.

(4) WELL SITES. The suitability of a site for a well is dependent on geological and topographic conditions and possible sources of contamination. However, the following general requirements must be met:

(a) The lot or parcel of land reserved for the construction of a well shall have minimum dimensions of 100 feet by 100 feet with the well located near its center. These dimensions may be modified by the department on a case-by-case basis if it is demonstrated that they are unnecessary to fulfill the requirements of this chapter.

(b) Wells may be constructed or replaced on sites in the flood plain outside of the floodway provided that the pumphouse floor is 2 feet or more above the regional flood elevation. No new well shall be constructed or existing well reconstructed on a site in a floodway. (Refer to chapter NR 116 for floodplain and floodway criteria.)

(c) Well sites shall be inspected by a representative of the department prior to approval of plans.

(5) CASING AND LINER PIPE FOR DRILLED WELLS. (a) The protective casing shall be new pipe produced to A.S.T.M., A-53, A-106, A-120 (1972); A.P.I., 5L, 5LX (March, 1973) or A.W.W.A. 202 (January 25, 1965) specifications. No previously used or reclaimed pipe shall be used.

(b) The protective casing shall have the minimum weights and thicknesses given in Table 1 except for the allowable variances outlined in (c) below. Wrought iron pipe shall meet A.W.W.A. standard A-100 (January 23, 1966).

(c) If the protective casing is to be installed without driving it may have a thickness less than indicated in Table 1 but shall be surrounded by at least 4 inches of grout. It shall have a minimum thickness of 0.322 inches except in the case of 6-inch diameter casing which shall be a minimum of 0.280 inches.

(d) Liner pipe installed to seal off a caving zone shall be new, unused and nonreclaimed pipe, but may have a lesser thickness than given in Table 1.

(e) All casings and liners shall have additional thickness and weight if standard thickness is determined by the department to be insufficient to assure reasonable life expectancy or withstand forces to which they may be subjected.

(f) Casing and liner pipe shall be equipped with drive shoe when driven.

(g) Casing and liner pipe shall have welded or threaded pipe joints.

(h) Copies of the above specifications and standards are available for inspection at the office of the department of natural resources, the secretary of state's office and the office of the revisor of statutes, and may be obtained for personal use from the American Society for Testing and Material, 1916 Race St., Philadelphia, Pennsylvania, 19103, American Petroleum Institute, 300 Corrigan Tower Building, Dallas, Texas, 75201, American Water Works Association, 6666 West Quincy Ave., Denver, Colorado, 80235.

Table 1

STEEL PIPE*

SIZE (inches)	DIAMETER (inches)		THICKNESS (inches)	WEIGHT PER FOOT (pounds)	
	EX-TERNAL	IN-TERNAL		PLAIN ENDS (calculated)	WITH THREADS AND COUPLINGS (nominal)
6 id.	6.625	6.065	0.280	18.97	19.18
8	8.625	7.981	0.322	28.55	29.35
10	10.750	10.020	0.365	40.48	41.85
12	12.750	12.000	0.375	49.56	51.15
14 od.	14.000	13.250	0.375	54.57	57.00
16	16.000	15.250	0.375	62.58	65.30
18	18.000	17.250	0.375	70.59	73.00
20	20.000	19.250	0.375	78.60	81.00
22	22.000	21.000	0.500	114.81	
24	24.000	23.000	0.500	125.49	
26	26.000	25.000	0.500	136.17	
28	28.000	27.000	0.500	146.85	
30	30.000	29.000	0.500	157.53	
32	32.000	31.000	0.500	168.21	
34	34.000	33.000	0.500	178.89	
36	36.000	35.000	0.500	189.57	

* Abstracted from AWWA Standard for Deep Wells, AWWA A100-66, p. 34 & 35.
A copy of the above standard is available for inspection at the office of the department of natural resources, the secretary of state's office and the office of the revisor of statutes, and may be obtained for personal use from the American Water Works Association, 6666 West Quincy Ave., Denver, Colorado, 80235.

(6) CONCRETE WALL CASING. Concrete wall casing shall:

(a) Be used only in dug wells and collectors;

(b) Be reinforced and at least 6 inches thick;

(c) Be poured in one operation, if possible;

(d) Not have a construction joint within 10 feet of original ground surface.

(7) PACKERS. Packers shall be of a material that will not impart taste, odors, toxic substances or bacterial contamination to the water in the well.

(8) SCREENS. Screens shall:

(a) Be constructed of material which will not be damaged by chemical action of ground water or future cleaning operations;

(b) Have size of openings based on sieve analysis of the aquifer materials;

(c) Be installed and have pumping equipment designed so that exposure above pumping level will not occur during normal operation.

(9) BLASTING. Approval shall be obtained from the department prior to blasting within a well. Information regarding the procedure, number, size and location of charges shall be submitted in writing to the department for approval.

(10) CHEMICAL CONDITIONING. Specifications shall include method proposed, equipment, chemicals, testing for residual chemicals, disposal of waste, and inhibitors to be used.

(11) GROUTING REQUIREMENTS. (a) Neat cement grout shall be cement and water with not more than 6 gallons of water per sack (94 lbs.) of cement. Approved additives may be used to increase fluidity, reduce shrinkage or control time of set.

(b) Concrete grout may be used where large quantities of materials are required and the annular opening is greater than 6 inches. The mixture shall consist of cement, sand and water in the proportion of one sack (94 lbs.) of cement and an equal volume of dry sand mixed with not more than 6 gallons of clean water. Gravel not larger than one-half inch in size may be included in the proportion of sand.

(c) Application of grout: 1. For depths in excess of 100 feet, grout shall be installed by means of a grout pump from the bottom of the annular opening upward in one continuous operation until the annular opening is filled. For lesser depths, the grout may be allowed to flow by gravity through a conductor pipe. The lower end of the grout pipe shall be submerged in grout during the entire operation.

2. Sufficient annular opening shall be provided to permit a minimum of 1½ inches of grout around the protective casing, including couplings, if used.

3. Any materials used as drilling aids shall be removed from the annular opening prior to grouting.

4. Prior to grouting through creviced formations, bentonite or similar approved materials may be added to the annular opening in the manner indicated for grouting.

5. Grout shall be allowed to overflow from the annular opening until such time as the density is the same as that of the grout being placed. The specifications shall outline the method to be used to check the grout density.

6. Standby equipment and materials in sufficient quantities for continuously placing grout from the bottom upwards in the annular opening shall be available at the well site when the primary grouting method involves forcing a measured quantity of grout down the inner casing by a plug (Halliburton method).

7. In individual cases, partial withdrawal of the outer casing may be necessary during grouting to comply with NR 111.30 (1) (c). The grout level shall be maintained above the bottom of the outer casing during the withdrawal procedure.

8. Plastic pipe is not permitted for use as a conductor pipe.

(d) Protective casing shall be provided with sufficient centering guides welded to the casing to permit unobstructed flow and uniform thickness of grout.

(e) No drilling operations or other work in the well will be permitted within 72 hours after the grouting of casings or liners. If quick-setting cement is used, this period may be reduced to 24 hours.

(12) PLUMBNESS AND ALIGNMENT REQUIREMENTS. (a) Every well constructed in rock shall be tested for plumbness and alignment by the method outlined in A.W.W.A. Standard A-100 (January 23, 1966) or by an equivalent method. The test method shall be clearly stated in the specifications. A copy of the A.W.W.A. standard is available for inspection at the office of the department of natural resources, the secretary of state's office and the office of the revisor of statutes, and may be obtained for personal use from the American Water Works Association, 6666 West Quincy Ave., Denver, Colorado, 80235.

(b) Variance from the vertical of two-thirds the smallest inside diameter of that part of the well being tested per 100 feet of depth to the depth of the pump setting plus 25% shall not be exceeded. Also, the well shall allow free passage of a 40-foot section of pipe or a dummy to the depth of the pump setting plus 25%. The outside diameter of the pipe or dummy used shall not be more than ½ inch smaller than the diameter being tested.

(c) Kinks and bends which prevent setting a line shaft pump to the desired pump setting plus 25% will not be approved by the department unless accepted by the owner.

(d) A summary of the test results shall be submitted to the department prior to permanent pump approval.

(13) YIELD AND DRAWDOWN TEST. (a) A yield and drawdown test is required, and the method to be used shall be clearly indicated in the plan specifications.

(b) The test shall be performed on every well for a period of at least 12 consecutive hours in duration.

Note: It is recommended that the pump test be continued beyond 12 hours or until the water level stabilizes.

(c) The test shall include pumping a minimum of 4 hours at a rate equal to the capacity anticipated for the permanent well pump.

(d) Water depth measurements shall be made at least every one-half hour during the testing period.

(e) The following data shall be submitted to the department:

1. Static water level;
2. Pumping rate;
3. Drawdown during test;
4. Recovery water levels;
5. Depth of pump setting.

(f) In addition, samples of water shall be collected as required by subsections (16) and (17) following.

(14) GEOLOGICAL DATA. (a) Formation samples shall be collected at 5-foot intervals and at each pronounced change in formation.

(b) Geological data shall be recorded on the construction report and the formation samples submitted to the Wisconsin State Geo-

logical and Natural History Survey, 1815 University Ave., Madison, Wisconsin 53701.

(15) CAPPING REQUIREMENTS. (a) Wells in which no pump is installed shall be capped by welding a plate to the top of the casing.

(b) During construction, a temporary means of capping shall be provided to prevent debris or any contaminants from entering the well.

(16) BACTERIOLOGICAL QUALITY. Every new, modified or reconditioned ground water source shall be disinfected during or after placement of pumping equipment. Samples for bacteriological analysis shall be collected as provided in NR 111.23 (3).

(17) CHEMICAL QUALITY. (a) Every new or modified well shall be sampled for complete chemical analysis. Reconditioned wells shall be sampled for chemical analysis in cases where changes in water quality may occur. The samples shall be collected near the end of the test pumping period and submitted as soon as practical to the state laboratory of hygiene, Madison. Bottles, sampling slips, and authorization for the sampling may be obtained at a district office of the department.

(b) Determination of pH shall be made in the field and recorded on the sampling slips.

(c) Samples for iron analysis must be acidified.

(d) A minimum of one quart of water is required for a complete chemical analysis.

(18) OBSERVATION WELLS AND TEST WELLS. (a) Observation and test wells shall be constructed in accordance with the requirements for permanent wells if they are to remain in service after completion of ground water supply. If not to remain in service, they shall be abandoned in accordance with section NR 111.26.

(b) Observation and test wells shall be protected at the upper terminal to preclude entrance of foreign material.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

NR 111.31 Special requirements for ground water sources developed in unconsolidated formations (sand and gravel). (1) SCREENED WELLS. (a) The cased and grouted depth will be dependent on the controlling geologic conditions. Where practical, the grouted casing shall extend to at least 5 feet below the normal pumping water level and to within 5 feet of the top of the screen. Grouted casing depths less than 30 feet will not be approved if suitable alternatives are available.

(b) Continuous chlorination and an adequate contact time will be required as a safeguard except in cases where the proposed well construction provides sufficient protection as determined by the department.

(c) Prior to constructing the final well the owner must have obtained sufficient land or easements around the well site to protect the well from potential hazards. Approval of the well will not be granted unless adequate protection of the site can be assured.

(d) If clay or hardpan is encountered above the formation to be developed, the inner casing and grout shall extend through such materials, but the outer casing shall be withdrawn at least 5 feet above the clay or hardpan during grouting.

(e) The outer casing may be entirely removed during grouting,

but the grout level shall be above the bottom of the casing at all times.

(f) If the well is gravel packed, the gravel shall be acid resistant and free of foreign material, properly sized, washed, and disinfected prior to or during placement.

(g) A seal to prevent leakage of grout into the gravel pack or screen shall be provided.

(h) Gravel refill pipes and observation pipes, when used, shall be surrounded by a minimum of 1½ inches of grout if installed in the grouted annular opening. Pipes shall be incorporated into the concrete pump foundation to a point at least 4 inches above the floor, and shall terminate with a threaded cap at least 12 inches above the pumphouse floor.

(2) RADIAL COLLECTORS. (a) Continuous chlorination shall be provided.

(b) Acceptability of the site, as provided in NR 111.30 (4), shall be determined prior to any intensive investigation.

(c) The area around the laterals shall be under the control of the water purveyor for a distance approved by the department.

(d) The location of all caisson construction joints and porthole assemblies shall be indicated on the plans.

(e) The caisson wall shall be of reinforced concrete as provided in NR 111.30 (6).

(f) Provisions shall be made to assure minimum vertical rise of the caisson.

(g) The top of the caisson shall be covered with a watertight concrete floor, and all openings in floor shall be curbed and have overlapping covers to protect against the entrance of foreign material.

(h) The pump discharge piping shall not be placed through caisson walls.

(3) DUG WELLS AND SPRINGS. (a) Dug wells and springs shall be approved only when it is not feasible to develop a drilled well.

(b) Plans shall include facilities for continuous chlorination and an adequate chlorine contact time before the water reaches consumers.

(c) Springs shall be housed in a permanent concrete structure which terminates above the ground surface and which prevents the entry of surface water.

(d) Dug wells shall be covered by a watertight concrete cover which terminates not less than 12 inches above the permanent ground surface and shall have concrete casing as required in NR 111.30 (6).

(e) The dug well pump discharge piping shall not be placed through the concrete casing.

(f) The area around the well or spring shall be under the control of the water purveyor for a distance approved by the department.

(4) INFILTRATION LINES. (a) Infiltration lines will be permitted only when it is not feasible to develop an acceptable well.

(b) Plans shall include facilities for continuous chlorination and an adequate chlorine contact time before the water reaches consumers.

(c) The area around the lines shall be under the control of the water purveyor for a distance approved by the department.

History: Cr. Register, November, 1974, No. 227, eff. 12-1-74.

NR 111.32 Special requirements for ground water sources developed in consolidated rock formations. (1) SANDSTONE WELLS. The requirements of this subsection apply to formations commonly referred to as sandstones in Wisconsin (Lake Superior sandstone, the St. Peter sandstone and the Upper Cambrian sandstones).

(a) Minimum depth of the grouted casing shall be 60 feet. The casing shall be installed to a depth of 10 feet below the anticipated pumping water level, except in cases when the department determines that this requirement is not necessary to meet the requirements of this chapter.

(b) When the sandstone is overlain by creviced limestone or shale formations, the grouted casings shall be installed a minimum of 15 feet into firm sandstone. The department shall be contacted for locations where this type of construction will be required.

(c) Where the depth of unconsolidated material is more than 60 feet, the protective casing shall be seated in firm sandstone where the sandstone is the upper rock formation.

(d) Where the depth of unconsolidated material is less than 60 feet and the sandstone is the upper rock formation, the department shall be contacted for required depth of grouted casing.

(2) LIMESTONE WELLS. This subsection applies to formations commonly referred to as limestones in Wisconsin (the Niagara dolomite, the Galena–Platteville dolomite, and the Prairie du Chien dolomite). The following requirements are intended primarily for wells located in limestone aquifers which are not overlain by consolidated shale or sandstone formations.

Note: When an acceptable sandstone aquifer can be utilized, construction of limestone wells should be avoided.

(a) Continuous chlorination and chlorine detention time shall be required as a safeguard for limestone wells when the department determines that additional protection is necessary. However, chlorination shall not be allowed as an alternative where a well shows evidence of contamination and can be reconstructed or replaced.

(b) Where the depth of unconsolidated material overlying the limestone is 60 feet or greater for a minimum radius of ½ mile and there is no record of sinkholes, quarries, improperly constructed wells or outcrops within that area, the miimum depth of grouted casing shall be 60 feet. The casing shall be installed to a depth 10 feet below the anticipated pumping water level unless the department waives this requirement after finding it unnecessary in meeting the requirements of this chapter.

(c) Where the depth of unconsolidated material is more than 60 feet and only 60 feet of grouted casing is required, the protective casing shall be seated in firm limestone.

(d) Where the depth of unconsolidated material is less than 60 feet at the well site or within one-half mile of the well site, the department shall be contacted for minimum depth of grouting casing. An inner casing size of at least 12″ diameter will be required to permit the installation of grouted liner at a future date if the water from the well shows evidence of contamination.

Note: The casing size requirement may be waived by the department if it is demonstrated that it is unnecessary to meet the requirements of this chapter. In such cases, a minimum of 100 feet of grouted casing is usually required and, where conditions dictate, considerably more than 100 feet will be required.

(3) GRANITE WELLS. The department shall be contacted for specific constructional requirements for all proposed developments of wells in Precambrian igneous and metamorphic rock (commonly referred to as "granite".)

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

NR 111.33 Well pumping stations. (1) GENERAL. The following sections cover specific requirements for ground water well pumping stations. (See Part 4, NR 111.43, for additional pumping station requirements.) Pumping facilities shall be designed to maintain the sanitary quality of pumped water. Subsurface pits or pump rooms and inaccessible installations shall not be permitted.

(2) SITE PROTECTION. The station shall be:

(a) Landscaped to lead surface drainage away from the station; the floor shall be a minimum of 6″ above the finished ground surface and at least 2′ above the regional flood elevation;

(b) Protected to prevent vandalism and entrance by animals or unauthorized persons.

(3) BUILDINGS. All buildings constructed in connection with the station shall:

(a) Have at least one door opening to the outside;

(b) Have a roof hatch located over the well;

(c) Be of sufficient size to provide ease of access and adequate room for chemical feed equipment;

(d) Be adequately drained.

(4) PUMP STATION DRAINS. Pumping station drains shall:

(a) Have no floor drain inlet within 2 feet of the well casing;

(b) Be constructed of cast iron pipe within 10 feet of the well casing, except for shallow wells where concrete encasement may be required;

(c) Not be connected to storm or sanitary sewers unless there is assurance of no backup of wastewater above the pump station floor;

(d) Be a minimum of 25 feet from the well if a gravel pocket is used except that greater distance may be required for wells developed in sand and gravel formations.

(5) DUG WELLS AND COLLECTORS. Pumping stations shall have a watertight concrete floor. All openings in the floor shall be curbed and protected against the entrance of foreign material. The entrance hatch in the floor shall be located adjacent to and inside of the well perimeter; have a curb at least 4 inches high; have the edge of the cover extending down over the curb at least 2 inches; and be kept locked when not in use.

(6) DRILLED WELLS. Pumping stations located over drilled wells shall:

(a) Have a casing extending 12 inches above the floor unless a lower elevation is approved by the department after finding it unnecessary to comply with other requirements of this chapter. In no case shall an elevation of less than 6 inches be approved (see Fig. 3).

(b) Have a concrete pump foundation which prevents floor drainage water from coming into contact with the inner well casing.

(c) Have a casing extending above the concrete pump foundation so that the casing will project at least 1 inch into the base of the

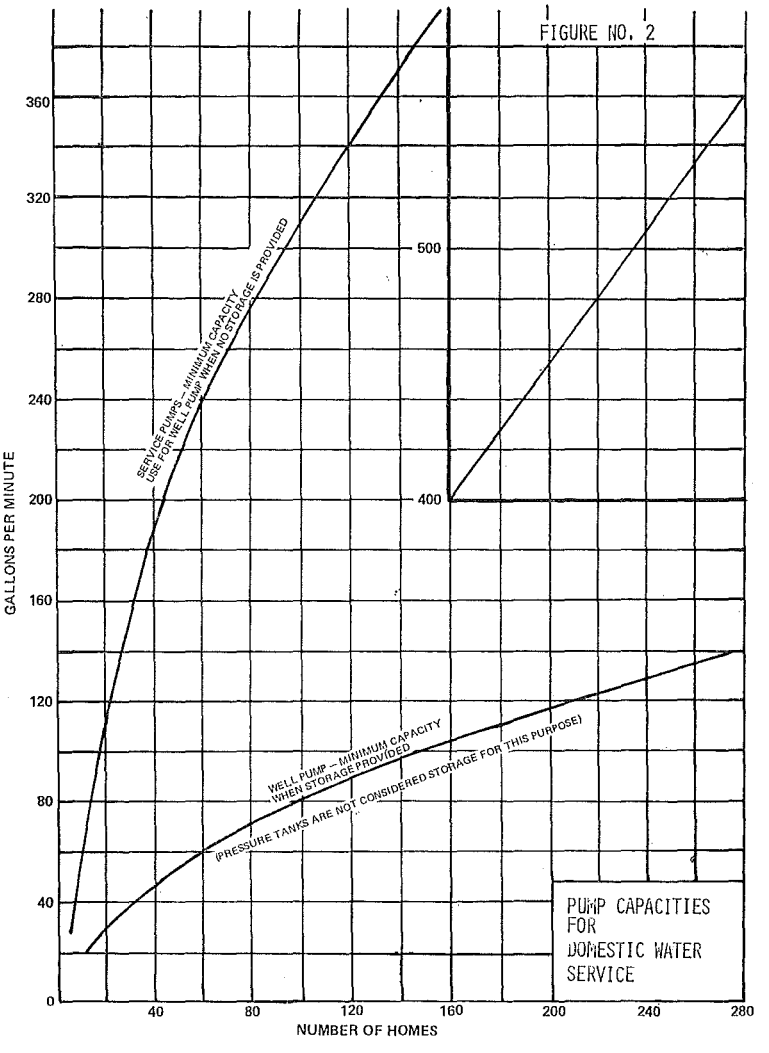
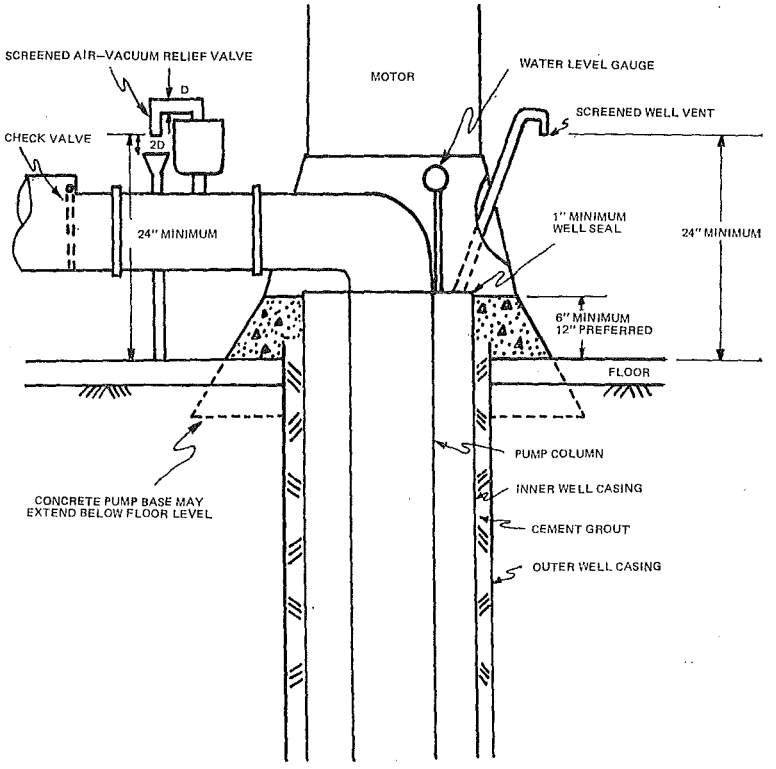


FIGURE NO. 2
GALLONS PER MINUTE
NUMBER OF HOMES
0
40
80
120
160
200
240
280
320
360
40
80
120
160
200
240
280
500
400
SERVICE PUMPS – MINIMUM CAPACITY USE FOR WELL PUMP WHEN NO STORAGE IS PROVIDED
WELL PUMP – MINIMUM CAPACITY WHEN STORAGE PROVIDED
(PRESSURE TANKS ARE NOT CONSIDERED STORAGE FOR THIS PURPOSE)
PUMP CAPACITIES FOR DOMESTIC WATER SERVICE

FIGURE NO. 3



TYPICAL WELL PUMP INSTALLATION - PUBLIC SUPPLY WELLS

pump. The metal surfaces between the pump head and base plate shall be machined or gasketed to provide a tight seal. A gasket or grout seal shall be provided between the base plate and concrete pump foundation.

(7) SUBMERSIBLE PUMPS. Where a submersible pump is used, the top of the casing shall be effectively sealed against entrance of water under all conditions of vibration or movement of conductors or cables. The casing shall terminate at least 12 inches above the floor and be surrounded by a concrete pad to at least 6 inches above the floor.

History: Cr. Register, November, 1974, No. 227, eff. 12-1-74.

NR 111.34 Pumping equipment. (1) PUMP CAPACITIES. Figure 2 shall be used for determining pump capacities for domestic water service only. More detailed engineering studies are necessary for determining

pump capacities in systems providing water for multiple uses, including domestic, commercial and industrial usage and fire protection. (See NR 111.60 (2) for multiple pump requirements.)

(2) PUMP LUBRICATION. (a) Water lubricated pumps are required, except where oil lubricated pumps are necessary to provide positive lubrication at deep pump settings. However, in no case shall oil lubricated pumps be approved for wells in unconsolidated formations, wells with shallow pump settings or wells where the casing does not extend below the pumping water level.

(b) On water lubricated pumps with static water levels deeper than 50 feet, provision shall be made for prelubricating the column bearings prior to pump startup. If auxiliary power is provided, additional valving of the prelubrication water will be necessary. When pump backspin is allowed to occur after the motor shuts off the necessity for lubrication during this period shall be determined by the design engineer and provided if necessary.

(3) MOTOR PROTECTION. Where backspin can be expected to occur, a time delay or backspin ratchet shall be provided to protect the motor in the event the pump controls are energized before the pump stops backspinning.

(4) WELL VENT. Each well shall be vented to the atmosphere by installing a vent pipe which terminates in a fine screened "U" bend at least 24 inches above the floor. If the well is flowing, the vent shall terminate above the artesian water level or a suitable automatic valve shall be provided. (See Fig. 3.)

(5) WATER LEVEL MEASUREMENTS. (a) Provisions shall be made for measurement of static and pumping water levels in the completed well.

Note: This will usually consist of an electric depth gauge or an airline attached to the pump column and an altitude gauge.

(b) Installation shall be made in such manner as to prevent entrance of foreign material.

(6) DISCHARGE LINES. Lines which are to be buried shall be designed so that the line is under a continuous pressure head which is higher than the elevation of the ground surface. The following shall be provided within the pumphouse:

(a) Air-vacuum relief valve. Well discharge lines with check valves shall have an air-vacuum relief valve installed between the well and check valve. The discharge line from the relief valve shall face downward and terminate with a fine screen, at least 24 inches above the floor. (See Fig. 3.)

(b) Meters. All wells shall be provided with water meters to determine the quantity of water discharged.

(c) Sampling tap. All pump discharge piping shall contain a smooth end sampling tap. Where possible the tap shall be prior to any chemical addition points.

(d) Check valve or other type of automatically closing valve.

(e) Shut-off valve.

(f) Pressure gauge.

(7) SUCTION LINES. Buried suction lines which, under all operating

conditions, are not under a positive pressure head which is higher than the elevation of the ground surface will not be permitted.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

NR 111.35 Hydro-pneumatic tanks. Hydro-pneumatic or pressure tanks may be approved in the situations described in NR 111.60 of this chapter. The following requirements must be met:

(1) The tank shall be completely housed, or earth-mounded with one end projecting into an operating house, to prevent freezing. If the tank is installed below grade, all electrical controls and air release valves and any appurtenances which could permit water flooding the basement and contaminating the water supply shall be extended to at least 24″ above grade and terminate in a U-bend.

(2) The tank shall have bypass piping to permit operation of the system while the tank is being repaired or painted.

(3) Each tank shall have an access manhole, a drain, and control equipment consisting of pressure gauge, pressure relief valve, water sight glass, automatic air blow-off, and pressure or probe operated start-stop controls for the pumps.

(4) The gross volume, in gallons, of the hydro-pneumatic tank, shall be at least 10 times the capacity of the largest pump, rated in gallons per minute.

(5) An air compressor or other suitable means shall be provided to add air to the tank.

(6) Each tank shall be identified by stamping showing the manufacturer's name, a serial number, the allowable working pressure and the year fabricated.

(7) The tank shall have a ¼-inch minimum side wall and head wall thickness.

Note: For safety requirements, consult chapter 41, Boiler and Pressure Vessel Code, department of industry, labor and human relations.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

NR 111.36 Treatment. The design of treatment processes and devices shall depend on evaluation of the nature and quality of the particular water to be treated and the desired quality of the finished water. Following are the requirements of specific treatment processes.

(1) AERATION. Aeration treatment devices described in this subsection may be used for oxidation, separation of gases or for taste and odor control.

(a) *Natural draft aeration.* The design shall provide that:

1. Water is distributed uniformly over the top tray;

2. Water is discharged through a series of 3 or more trays with separation of trays not less than 6 inches;

3. Trays are loaded at rate of 1 gpm to 5 gpm for each square foot of total tray area;

4. Trays have slotted, woven wire cloth or perforated bottoms;

5. Perforations are 3/16 to ½ inches in diameter, spaced 1 to 3 inches on centers, when perforations are used;

6. 8 to 12 inches of inert media are used, such as coke or limestone, that will not disintegrate due to freezing cycles;

7. Aerated water receives disinfection treatment.

(b) *Forced or induced draft aeration.* Devices shall be designed to:

1. Provide adequate countercurrent flow of air through enclosed aeration column;

2. Be insect-proof and lightproof;

3. Be such that the air intake is located above grade and the air introduced into column is passed through insect-tight screen and be as free of dust as possible;

4. Insure that water outlet is adequately sealed to prevent unwanted loss of air;

5. Be such that sections of the aerator can be easily reached and removed for maintenance.

(c) *Pressure aeration.* This method may be used for oxidation purposes if a pilot plant study indicates the method's effectiveness; it will not be approved for removal of dissolved gases. Filters following pressure aeration shall have adequate exhaust devices for release of air. Pressure aeration devices shall be designed to cause a thorough mixing of compressed air with water being treated, and shall provide screened and filtered air, free of obnoxious fumes, dust, dirt and other contaminants.

(d) *Other methods of aeration.* Other methods of aeration may be permitted if their effectiveness is demonstrated and approved by the department. Such methods include but are not restricted to spraying, diffused air and mechanical aeration. The treatment processes shall be designed to meet the particular needs of the water to be treated.

(e) *Protection from wind.* Aerators that discharge through the atmosphere shall be protected by being placed in a louvered enclosure designed to provide easy access to the interior.

(f) *Protection from contamination.* Aerators that are used for oxidation or removal of dissolved gases from waters that will be given no further treatment other than chlorination shall be protected from contamination from insects and birds and windborne debris or dust.

(2) IRON AND MANGANESE CONTROL. Iron and manganese control, as used in this subsection, refers solely to treatment processes designed specifically for this purpose. The treatment process used will depend upon the character of the raw water. The selection of treatment processes shall meet specific local conditions as determined by engineering investigations, including chemical analyses of representative samples of water to be treated. The department may require the operation of a pilot plant in order to gather all information pertinent to the design. Following are requirements for specified treatment processes.

(a) *Removal by oxidation-detention-filtration or oxidation-filtration.*

1. Oxidation may be by aeration, as indicated in subsection (1), or by chemical oxidation with chlorine or potassium permanganate.

2. A detention period of ½ to 3 hours, as determined by pilot studies, shall be provided following oxidation by aeration in order to insure that the oxidation reactions are as complete as possible. The detention period may be omitted where a pilot plant study indicates no need for detention and department approval is obtained. The detention basin shall be designed as a holding tank with sufficient baffling to prevent short circuits. Sludge collection equipment is not required; however, the floor shall be sloped to facilitate cleaning. Sedimentation basins shall be provided when treating water with high iron or manganese content or where chemical coagulation is used to reduce the load on the filters.

3. Use of rapid rate pressure filters as well as gravity filters may be considered for iron and manganese removal. Use, however, is subject to the following conditions:

a. Minimum criteria relative to number, rate of filtration, structural details and hydraulics, filter media, etc., provided for rapid rate gravity filters in NR 111.45 also apply to pressure filters where appropriate.

b. Generally, the design filtration rate shall be three gallons per minute per square foot of filter area. High or lower rates may be justified based on in-plant or pilot plant studies.

c. Filter design shall provide for:

1) Loss of head gauges with a suitable range in head on the inlet and outlet pipes of each filter;

2) An easily readable meter or flow indicator on each battery of filters; a flow indicator is recommended for each filtering unit;

3) Filtration and backwashing of each filter individually with an arrangement of piping as simple as possible to accomplish these purposes;

4) Minimum side wall shell height of 5 feet;

Note: A corresponding reduction in side wall height may be approved where proprietary bottoms permit reduction of the gravel depth.

5) Wastewater collection 18 inches above the surface of the media;

6) An underdrain system to efficiently collect the filtered water and distribute the backwash;

7) Backwash and air relief valves terminating with an air break at least 24 inches above the floor.

(b) *Removal by lime processes.* (See subsection (3) (a) following for requirements.)

(c) *Removal by units using potassium permanganate "regeneration".* This process, consisting of a continuous feed of potassium permanganate to the influent of a manganese greensand filter, is more applicable to the removal of iron plus manganese than to the removal of iron only because of economic considerations. As an alternate method, application of the potassium permanganate to the greensand on a "batch" basis may be considered. The following apply:

1. The permanganate shall be applied as far ahead of the filter as practical;

2. Other oxidizing agents or processes, such as chlorination or aeration, may be used prior to the permanganate feed to reduce the cost of the chemical;

3. Normal filtration rate shall be 3 gpm per square foot;

4. Normal wash rate shall be 8 to 10 gpm per square foot;

5. Air washing may be provided.

(d) *Removal by ion exchange.* This process of iron and manganese removal shall not be used unless pilot plant studies have demonstrated that satisfactory removal efficiencies can be continuously provided. There must be no oxidation of the iron or manganese prior to the process. (See subsection (3) (b) following for requirements.)

(e) *Sequestration.* This process is suitable only for low contents of iron and manganese, generally 1.0 mg/1 or less. Where phosphate treatment is used, chlorine residuals shall be maintained in the distribution system. In addition:

1. The point of application shall be prior to any aeration or oxidation and as far upstream as practical from the chlorine application.

2. A positive displacement type feeder equipped with an anti-siphon valve shall be used.

3. Chemicals for new or existing installations shall be approved by the department.

4. Stock phosphate solution shall be disinfected by carrying approximately 10 mg/1 chlorine residual.

(3) SOFTENING. The softening process selected shall be based upon the chemical qualities of the raw water, the desired finished water quality, the requirements for disposal of sludge or brine waste, the cost of plant and chemicals, and plant location. Applicability of process chosen shall be demonstrated and discussed in detail in the engineer's report. In areas of very hard water the sodium levels in cation exchange softened water shall be considered in selecting the treatment process. Following are requirements for specific processes:

(a) *Lime-soda process.* The applicable design standards for lime-soda softening of ground water are the same as those for conventional clarification-filtration surface water treatment plants, except that the minimum settling time can be reduced to two hours. Where softening is included in the surface water treatment process, the clarification criteria shall govern. (See NR 111.44 for criteria pertaining to softening with solids contact units and NR 111.45 for filtration requirements.) In addition:

1. Mechanical sludge removal equipment shall be provided in the sedimentation basin.

2. Determinations shall be made for the carbon dioxide content of the raw water.

Note: When concentrations exceed 10 milligrams per liter, the economics of removal by aeration as opposed to removal with lime should be considered. (See NR 111.36 (1) for aeration requirements.

3. Equipment for stabilization of water softened by the lime-soda process is required. (See NR 111.56 for stabilization requirements.)

4. Provisions shall be included for proper disposal of softening sludges. (See NR 111.86 for design requirements.)

5. The use of excess lime shall not be considered an acceptable substitute for chlorination or any other approved method of disinfection. (See NR 111.53.)

(b) *Ion exchange process.* Iron, manganese, or a combination of both in the oxidized state or unoxidized state, may cause resin fouling in the ion exchange process. Pretreatment shall be required whenever the content of iron, manganese, or a combination of both is one milligram per liter or more. In specific instances, the department may also require pretreatment where lesser amounts exist. In addition:

1. The units shall be of pressure or gravity type, of either an upflow or downflow design, using automatic or manual regeneration.

Note: Automatic regeneration is suggested for small plants.

2. The design capacity for hardness removal shall not exceed 20,000 grains per cubic foot when resin is regenerated with 0.3 pounds of salt per kilogram of hardness removed.

3. The depth of the exchange material shall not be less than 3 feet.

4. The rate of softening shall not exceed 7 gallons per square foot per minute, and the backwash rate shall be 6 to 8 gallons per square foot per minute.

5. The freeboard will depend upon the specific gravity of the media and the direction of water flow.

6. The bottoms, strainer systems and support for the exchange materials shall conform to criteria provided for rapid rate gravity filters in NR 111.45.

7. Facilities shall be included for even distribution of the brine over the entire surface of both upflow or downflow units. Backwash, rinse and air relief discharge pipes shall be installed in such a manner as to prevent back-siphonage.

8. A bypass shall be provided around softening units to produce a blended water of desirable hardness. Meters shall be installed on the bypass line and on each softener unit. An automatic proportioning or regulating device and shut-off valve shall be provided on the bypass line. The department may require treatment of the bypassed water to obtain acceptable levels of iron or manganese in the finished water.

9. Waters having 5 units or more turbidity shall not be applied directly to the cation exchange softener. Silica gel materials shall not be used for waters having a pH above 8.4 or when iron is present. When the applied water contains a chlorine residual the cation exchange material shall be a type that is not damaged by residual chlorine. Phenolic resin should not be used.

10. Brine storage tanks must conform to the following requirements:

a. The wet storage tank shall be designed to hold at least 1½ times the volume of salt delivered to permit refill before the tank is completely empty. The volume of both salt and brine storage to be provided will depend upon the size of the plant; the proximity and assuredness of the salt source, and the method of delivery.

b. The storage tank shall be isolated from possible sources of contamination, specifically:

1) It shall be properly covered and equipped with manholes having watertight covers to prevent entry of surface runoff;

2) Overflows and vents shall be designed in accordance with NR 111.62 (4) and NR 111.62 (6), respectively;

3) The water for filling the tank shall be distributed over the entire surface of the tank by pipes at least 2 pipe diameters above the maximum liquid level in the tank or be protected from back-siphonage;

4) The underdrain collection system shall be covered with a screen or perforated plate to allow brine but not salt to pass through.

c. A sampling tap shall be provided on the brine discharge line in order that the concentration of brine can be determined. A suitable means for measuring the volume of brine used for regeneration shall be provided.

Note: It is recommended that the interior concrete surfaces of brine storage tanks be painted with a salt-resistant sealing compound or paint to prevent deterioration.

11. Brine wastes. (See NR 111.84 for requirements.)

12. Sampling and testing. Smooth-end sampling taps shall be provided for control purposes. Taps shall be located on each raw water source, each treatment unit influent and each treatment unit effluent. Testing equipment shall be provided to adequately control the treatment process at all plants.

13. Stabilization. Water from ion exchange treatment plants shall be stabilized as required in NR 111.55 (4).

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

PART 4. SURFACE WATER—REQUIREMENTS FOR DESIGN AND CONSTRUCTION OF FACILITIES

NR 111.40 General requirements. The source of water selected shall provide the highest quality water reasonably available which, with appropriate treatment and adequate safeguards, will meet the drinking water standards in NR 111.22. Minimum treatment shall include disinfection, coagulation, sedimentation and filtration. The design of the treatment processes, equipment and structures shall depend on an evaluation of the nature and quality of the particular water to be treated. Variations from the design criteria may be approved by the department in cases where experimental, pilot or full scale studies have demonstrated that acceptable results can be obtained.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

NR 111.41 Intakes. Intake structures shall provide for:

(1) Velocity of flow .25 to .50 fps through the inlet structure so that frazil ice will be held to a minimum;

(2) Withdrawal of water from the depth of the best water quality;

(3) Inspection manholes every 1,000 feet for pipe sizes large enough to permit visual inspection;

(4) Adequate protection against rupture by dragging anchors, ice, and other activity;

(5) Locations referenced by permanent monuments.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

NR 111.42 Shore wells. Shore well structures shall:

(1) Have motors and electrical controls located above grade and flood level;

(2) Be accessible for operation and service;

(3) Be designed to prevent flotation;

(4) Be equipped with removable or traveling screens before the pump suction well;

(5) Provide chlorination or other chemical addition facilities for raw water transmission mains;

(6) Have the intake valved with provisions for backflushing and testing for leaks;

(7) Have provisions for controlling surges.

(8) The foregoing requirements may be waived by the department on a case-by-case basis if it is demonstrated that they are not necessary to fulfill the other requirements of this chapter.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

NR 111.43 Pumping stations. (1) GENERAL. Pumping facilities shall be designed to maintain the sanitary quality of the water being pumped. All raw or finished water pump stations shall:

(a) Have adequate space for the installation of additional units, if needed, and for the safe servicing of all equipment;

(b) Be durable, fire and weather resistant, and have outward opening doors;

(c) Have a floor elevation at least 6″ above the finished grade and at least 24″ above the regional flood level. Below grade installations will be permitted only if the terrain at the site is such that a gravity drain system can be provided;

(d) Have all floors drained without impairing the quality of water being handled;

(e) Provide a suitable outlet for drainage from pump glands without discharging onto the floor.

(2) SUCTION WELL. Suction wells, including installations where the pumps are installed on top of a reservoir, shall:

(a) Be watertight.

(b) Have bottoms sloped to permit removal of water and entrained solids.

(c) Be vented by means of a pipe or other device terminating in a screened u-bend at least 24″ above the floor.

(d) Have curbs a minimum of 4″ around all access openings, pipes, and other equipment which extend through the top of the suction well. Access openings shall have covers which overlap at least 2″.

(3) EQUIPMENT SERVICING. Pump stations shall be provided with:

(a) Crane-ways, hoist beams, eyebolts, or other facilities necessary for servicing or removal of pumps, motors or other heavy equipment;

(b) Openings in floors, roofs or wherever needed for removal of heavy or bulky equipment.

(4) STAIRWAYS AND LADDERS. Stairways or ladders shall be provided between all floors and in pits or compartments which must be entered.

Note: Applicants are also advised to consult requirements in applicable local and state codes.

(5) HEATING. Adequate heating shall be provided for the safe and efficient operation of the equipment.

Note: In pump houses not occupied by personnel, only enough heat need be provided to prevent freezing. Applicants are also advised that other requirements may exist in local and state codes.

(6) VENTILATION. (Ventilation for all pumping stations will be governed by applicable local and state codes.)

(7) DEHUMIDIFICATION. Means for dehumidification shall be provided in areas where excess moisture could cause safety hazards or damage to equipment or piping.

(8) LIGHTING. Pump stations shall be adequately lighted. (Reference should be made to the National Fire Code, Volume 5 (1973–1974), Electrical, and relevant state codes.

Note: A copy of Volume 5 of the Fire Code is available for inspection at the office of the department of natural resources, the secretary of state's office and the office of the revisor of statutes, and may be obtained for personal use from the National Fire Protection Association, 470 Atlantic Ave., Boston, Mass., 02210.

(9) SANITARY AND OTHER CONVENIENCES. All pumping stations shall be provided with potable water, lavatory and toilet facilities *except* unoccupied automatic stations or where such facilities are available elsewhere. Plumbing shall be installed in a manner to prevent contamination of the public water supply. Wastes shall be discharged in accordance with NR 111.81.

(10) PUMPS. Pumping stations shall:

(a) Have at least 2 pumping units except where additional pumping stations which can meet the peak demand are available or where the department determines that ample time will be available between pumping periods for necessary repairs. If only 2 units are provided, each shall be capable of carrying the peak demand. If more than 2 units are installed, they shall have sufficient capacity so that any one pump can be taken out of service with the remaining pumps capable of carrying the peak demand.

(b) Have controls for proper alternation where 2 or more pumps are installed. Provision shall be made to prevent operation of the pump during the backspin cycle. All electrical controls shall be located above grade.

(c) Provide a power supply from at least 2 independent sources or from a standby, auxiliary power source.

(d) Provide a prelubrication line with a valved bypass around the automatic control and backflow protection, if appropriate, whenever automatic prelubrication of pump bearings is necessary and an auxiliary power supply is provided.

(11) SUCTION LIFT. Suction lift shall be allowed only for distances of less than 15 feet and where provision is made for priming the pumps. Suction lift shall not be permitted if used with buried piping carrying finished water.

(12) PRIMING. Prime water shall not be of lesser sanitary quality than that of the water being pumped. Means shall be provided to prevent backflow. When an air-operated ejector is used, the screened intake shall draw clean air from a point at least 10 feet above the ground or other source of contamination, unless the air is filtered by apparatus approved by the department. Vacuum priming may be used.

(13) AUTOMATIC AND REMOTE CONTROLLED STATIONS. All automatic stations shall be provided with automatic signaling apparatus which will report pump operation (on-off) to the main station and shall also provide pressure monitoring if a separate pressure zone is established. All remote controlled stations shall be electrically operated and controlled and shall have reliable signaling apparatus. Installation of electrical equipment shall conform with the National Fire Code, Volume 5, Electrical (1973–1974).

Note: See NR 111.74 for booster pumping facilities in the distribution system. A copy of Volume 5 of the Fire Code is available for inspection at the office of the department of natural resources, the secretary of state's office and the office of the revisor of statutes, and may be obtained for personal use from the National Fire Protection Association, 470 Atlantic Ave., Boston, Mass., 02210.

(14) APPURTENANCES. (a) *Valves.* Pumps shall be adequately valved to permit satisfactory operation, maintenance, and repair of the equipment. If foot valves are provided, they shall have a net valve area of at least 2½ times the area of the suction pipe and shall be screened. Each pump shall have an automatically closing valve or check valve on the discharge side between the pump and shutoff valve.

(b) *Piping.* Piping shall be protected against surge or water hammer. In addition, each pump shall have an individual suction line

or lines so manifolded that they insure similar hydraulic and operation conditions.

(c) *Gauges and Meters.* Each pump shall have a standard pressure gauge on its discharge line and have a compound pressure gauge on its suction line. Where suction or discharge headers are utilized only one gauge is required on each header. In addition, the station shall have indicating, totalizing and recording metering of the total water pumped.

Note: Discharge pressure recording devices are recommended at the larger stations.

(d) *Water Seals.* Water seals shall not be supplied with water of a lesser sanitary quality than that of the water being pumped. Where pumps are sealed with potable water and are pumping water of lesser sanitary quality the water supply shall:

1. Be provided with a break tank open to atmospheric pressure;
2. Have an air gap, at least 6 inches or two pipe diameters, whichever is greater, between feeder line and spill line of the tank.

Note: *Painting of Piping.* In order to facilitate identification of piping in waterworks, pumping stations and plants, it is recommended that the following color scheme be utilized for purposes of standardization:

(a)	*Water Lines*	*Color*
	Raw	Olive Green
	Settled or Clarified	Aqua
	Finished or Potable	Dark Blue
(b)	*Chemical Lines*	*Color*
	Alum	Orange
	Ammonia	White
	Carbon Slurry	Black
	Chlorine (Gas and Solution)	Yellow
	Fluoride	Light Blue with Red Band
	Lime Slurry	Light Green
	Potassium Permanganate	Violet
	Sulfur Dioxide	Lt. Green with Yellow Band
(c)	*Waste Lines*	*Color*
	Backwash Waste	Light Brown
	Sludge	Dark Brown
	Sewer (Sanitary or Other)	Dark Gray
(d)	*Other Lines*	*Color*
	Compressed Air	Dark Green
	Gas	Red
	Other Lines	Light Gray

(e) If the situation develops where two colors do not have sufficient contrast to easily differentiate between them, it is suggested that a 6" band of a contrasting color be painted on one pipe at approximately 30" intervals. The name of the liquid or gas may also be painted on the pipe. In some cases it may be advantageous to paint arrows indicating the direction of flow.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

NR 111.44 Clarification. Plants designed for processing surface waters shall provide duplicate units for flocculation and sedimentation and be constructed to permit units to be taken out of service without disrupting operation. The following specific requirements shall also be met:

Note: In certain cases it may be desirable to design the piping to permit operation of basins in series or parallel.

(1) PRETREATMENT. Waters containing high turbidity or having unusual treatment requirements may require pretreatment, usually sedimentation or detention either with or without the addition of chemicals.

(a) *Basin design.* Sedimentation basins shall have a means for sludge removal.

(b) *Inlet.* Incoming water shall be dispersed across the full width of the line of travel as quickly as possible; short circuiting shall be prevented.

(c) *Bypass.* Provisions for bypassing sedimentation basins shall be included.

(d) *Detention time.* Three hours detention is the minimum period required for sedimentation; greater detention may be required in individual cases of chemical pretreatment.

(2) MIXING (FLASH OR RAPID). Mixing shall mean the rapid dispersion of chemicals throughout the water to be treated, usually by violent agitation.

(a) *Equipment.* Basins shall be equipped with mechanical mixing devices unless other methods, such as baffling, or injection of chemicals at a point of high velocity, are approved by the department after determining that the other requirements of this chapter will be met.

Note: Variable speed drive equipment is recommended.

(b) *Mixing.* The detention period for mechanical mixing shall be as short as possible depending upon the velocity gradient provided by the mixing units.

(3) FLOCCULATION (SLOW MIXING). Flocculation shall mean the agitation of water at low velocities for long periods of time.

(a) *Basin design.* Inlet and outlet design shall prevent short circuiting and destruction of floc. A drain shall be provided.

(b) *Detention.* Minimum flow-through velocity shall be not less than 0.5 nor greater than 1.5 feet per minute with a detention time for floc formation of at least 30 minutes.

(c) *Equipment.* Agitators shall be driven by variable speed drives or other means which vary the peripheral speed of paddles in the range of 0.5 to 2.0 feet per second. Uniform mixing shall be provided to prevent settling in the flocculation basin.

(d) *Piping.* Flocculation and sedimentation basins shall be as close together as possible. The velocity of flocculated water through pipes or conduits to settling basins shall be not less than 0.5 nor greater than 1.5 feet per second. Allowances shall be made to minimize turbulence at bends and changes in direction.

(e) *Other designs.* Baffling may be used to provide flocculation only after consultation with and approval by the department. The design shall be such that the velocities and flows set forth in this section will be maintained.

(4) SEDIMENTATION. Sedimentation shall follow flocculation. The detention time for effective clarification is dependent upon factors related to basin design as well as the nature of the raw water, such as turbidity, color and colloidal matter, and taste and odor causing compounds.

(a) *Detention time.* Plants with conventional sedimentation shall provide a minimum of four hours of settling time.

(b) *Inlet devices.* Inlets shall be designed to distribute the water equally and at uniform velocities. A baffle shall be constructed across the basin, close to the inlet end, and project several feet below the water surface to dissipate inlet velocities and provide uniform flows across the basin.

(c) *Outlet devices.* Outlet devices shall be designed to maintain velocities suitable for settling in the basin and to minimize short circuiting.

(d) *Weir overflow rate.* The rate of flow over the outlet weir shall not exceed 20,000 gallons per day per foot of weir length. If submerged ports are used as an alternate for overflow weirs, they should be not lower than 3 feet below the flow line.

(e) *Drainage.* Basins shall be provided with a means for dewatering. Basin bottoms shall slope toward the drain.

(f) *Covers.* Covers or superstructures are required at all plants. Where covers are used, manholes shall be provided as well as drop light connections so that observation of the floc can take place at the inlet, midpoint and outlet of the basin.

(g) *Velocity.* The velocity through settling basins shall not exceed 1.0 foot per minute. The basins shall be designed to minimize short circuiting. Baffles shall be provided if determined necessary by the department.

(h) *Overflow.* An overflow weir (or pipe) shall be installed which will establish the maximum water level on top of the filters. It shall discharge with a free fall at a location where the discharge will be visible.

(i) *Safety.* Guard rails shall be installed around openings which may be hazardous to maintenance personnel.

Note: State safety requirements should be consulted.

(j) *Sludge collection.* (Mechanical sludge collection equipment is recommended.)

(k) *Sludge disposal.* Facilities for disposal of sludge are required by the department. Provision shall be made for the operator to observe and sample sludge being withdrawn from the unit.

Note: Refer to NR 111.87 for additional specific requirements for sludge disposal.

(l) *Cross connection control.* Protection shall be provided for all potable water lines used to backflush sludge lines and basins or for other purposes if potable water could become contaminated by non-potable water.

(5) SOLIDS CONTACT UNIT. Units designed for combined softening and clarification will only be permitted if specifically approved by the department. Units shall be designed for the maximum uniform rate and be adjustable to changes in flow, which are less than the design rate, and for changes in water characteristics. A minimum of 2 units is required unless this requirement is waived by the department after a showing that it is not necessary to meet the other requirements of this chapter.

(a) *Installation of equipment.* Supervision by a representative of the manufacturer shall be provided whenever mechanical equipment is installed and, also, at the time of initial operation.

(b) *Operating equipment.* Laboratory equipment to control the treatment process shall be provided at all waterworks. In addition, sampling taps with adequate piping located to permit the collection of samples of water from critical portions of the units shall be provided.

(c) *Chemical feed.* Chemicals shall be applied at points and by

means which insure satisfactory mixing of the chemicals with the water.

(d) *Mixing.* Mixing devices employed shall be constructed to provide adequate mixing of the raw water with previously formed sludge particles, and to prevent deposition of solids in the mixing zone.

(e) *Flocculation.* Flocculation equipment shall be adjustable; provide for coagulation to occur in a separate chamber or baffled zone within the unit; and provide a flocculation and mixing period of not less than 30 minutes.

(f) *Sludge concentrators.* The equipment shall provide either internal or external concentrators in order to obtain a concentrated sludge with a minimum of wastewater.

(g) *Sludge removal.* Sludge removal design shall provide:

1. Sludge pipes not less than three inches in diameter, arranged to facilitate cleaning;
2. Entrance to sludge withdrawal piping to prevent clogging;
3. Valves located outside the tank for accessibility;
4. Facilities for an operator to observe or sample sludge being withdrawn from the unit.

(h) *Cross-connections.* Blow-off outlets and drains shall terminate and discharge at places approved by the department. Cross-connection control shall be included for all potable water lines such as those used to backflush sludge lines, flush basins if potable water could become contaminated by nonpotable water.

(i) *Detention period.* The detention time shall be established on the basis of the raw water characteristics and local conditions that affect the operation of the unit. Based on design flow rates, the minimum detention time shall be two hours for suspended solids contact clarifiers, and one hour for the suspended solids contact softeners.

(j) *Suspended slurry concentrate.* Softening units shall be designed so that continuous slurry concentrates of one percent or more, by weight, can be effectively maintained.

(k) *Water losses.*

1. Units shall be provided with suitable controls for sludge withdrawal.
2. Total water losses shall not exceed 5% for clarifiers or 3% for softening units.
3. Solids concentration of sludge discharged to waste shall be at least 3 percent by weight for clarifiers and 5% by weight for softeners.

(f) *Sludge concentrators.* The equipment shall provide either internal or external concentrators in order to obtain a concentrated sludge with a minimum of wastewater.

(g) *Sludge removal.* Sludge removal design shall provide:

1. Sludge pipes not less than 3 inches in diameter, arranged to facilitate cleaning;
2. Entrance to sludge withdrawal piping to prevent clogging;
3. Valves located outside the tank for accessibility;
4. Facilities for an operator to observe or sample sludge being withdrawn from the unit.

(h) *Cross-connections.* Blow-off outlets and drains shall terminate and discharge at places approved by the department. Cross-connection control shall be included for all potable water lines such as those

used to backflush sludge lines, flush basins if potable water could become contaminated by nonpotable water.

(i) *Detention period.* The detention time shall be established on the basis of the raw water characteristics and local conditions that affect the operation of the unit. Based on design flow rates, the minimum detention time shall be two hours for suspended solids contact clarifiers, and one hour for the suspended solids contact softeners.

(j) *Suspended slurry concentrate.* Softening units shall be designed so that continuous slurry concentrates of 1% or more, by weight, can be effectively maintained.

(k) *Water losses.* 1. Units shall be provided with suitable controls for sludge withdrawal.

2. Total water losses shall not exceed 5% for clarifiers or 3% for softening units.

3. Solids concentration of sludge discharged to waste shall be at least 3% by weight for clarifiers and 5% by weight for softeners.

(l) *Weirs or orifices.* The units shall be equipped with either overflow weirs or orifices. Weirs shall be adjustable, at least equivalent in length to the perimeter of the tank, and constructed so that surface water does not travel over 10 feet horizontally to the collection trough.

(m) *Weir or orifice loading.* Weir loading shall not exceed 20 gallons per minute per foot of weir length for units used for softeners, or 10 gallons per minute per foot of weir length for units used for clarifiers. Orifices shall produce uniform rising rates over the entire area of the tank.

(n) *Upflow rates.* Unless supporting data is submitted to the department and an exception granted, the following rates shall not be exceeded:

1. 1.75 gallons per minute per square foot of area at the slurry separation line if units are used for softeners.

2. 1.0 gallon per minute per square foot of area at the sludge separation line if units are used for clarifiers.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

NR 111.45 Filtration. The application of any type of filter and media must be supported by water quality data representing a period of use sufficient to characterize any variations in water quality. Experimental or pilot plant treatment studies may be required to demonstrate the applicability of the method or rate of filtration proposed. Pressure filters will not be approved for surface water applications. The following specific requirements must be met:

(1) RAPID RATE GRAVITY FILTERS. (a) *Pretreatment.* Rapid rate gravity filters shall only be utilized after coagulation, flocculation and sedimentation.

(b) *Number.* At least 2 filter units shall be provided. Provisions shall be made to meet the maximum day demand at the approved filtration rate with one filter out of service.

(c) *Rate of filtration.* The permissible rate of filtration shall be determined after consideration of such factors as raw water quality, degree of pretreatment provided, filter media, water quality control parameters, competency of operating personnel and other factors required by the department. In all cases the filtration rate shall be

proposed by the design engineer and approved by the department prior to the preparation of final plans.

(d) *Structural details and hydraulics.* The filter structure shall be designed to provide:

1. Vertical walls within the filter;
2. No protrusion of the filter walls or other structures into the filter media or the area between the top of the media and the high water line during backwashing;
3. Cover by superstructure;
4. Head room to permit normal inspection and operation;
5. Minimum filter depth of 8½ feet;
6. Minimum water depth over the surface of the media of three feet;
7. Trapped pipe or conduit effluent to prevent backflow of air to the bottom of the filters;
8. Prevention of floor drainage to the filter with a minimum 4-inch curb around the filters;
9. Prevention of flooding by providing overflow if this is not provided in a pretreatment unit;
10. Maximum velocity of treated water in the pipe and conduits to the filter of 2 feet per second;
11. Cleanouts and straight alignment for influent pipes or conduits where solids loading is heavy or following lime-soda softening;
12. Washwater drain capacity to carry maximum backwash flow;
13. Walkways around filters not less than 24 inches wide;
14. Safety handrails or walls around the filter areas adjacent to walkways.

Note: Consult local and state codes for requirements.

(e) *Washwater troughs.* Washwater troughs shall be so designed as to provide:

1. A bottom elevation above the maximum level of expanded media during washing;
2. A top elevation not exceeding 30 inches above the filter surface;
3. A 2-inch freeboard at the maximum rate of wash;
4. A top or edge which is level;
5. Spacing so that each trough serves the same number of square feet of filter area;
6. A maximum horizontal travel of suspended particles not exceeding 3 feet in reaching the trough.

(f) *Filter media.* 1. Sand—The media shall be clean silica sand having a depth of not less than 24 inches and not more than 30 inches; an effective size of from 0.45 mm to 0.55 mm, depending upon the quality of the raw water; and a uniformity coefficient not greater than 1.65.

2. Anthracite—Clean crushed anthracite or sand and anthracite will be approved if supported by experimental data obtained from the project. Anthracite used as the only media shall have an effective size from 0.45 mm to 0.8 mm and a uniformity coefficient not greater than 1.6. Anthracite used to cap sand filters shall have an effective size from 0.7 mm to 1.2 mm and a uniformity coefficient not greater than 1.85.

3. Granular Carbon—(See NR 111.46 for requirements)

4. Other media may be approved, but only on the basis of pilot

tests and experience which demonstrate that the requirements of this chapter will be met.

5. Supporting Media—Torpedo sand and gravel shall be provided as supporting media except when proprietary filter bottoms are used. In that case, the department, on the basis of substantiating information provided by the owner, may allow elimination of certain layers of supporting media or a reduction in the depth of the layers. Otherwise, the following apply:

a. Torpedo Sand—A 3-inch layer of torpedo sand shall be used as a supporting media for the filter sand. The torpedo sand shall have an effective size of 0.8 mm to 2.0 mm, and a uniformity coefficient not greater than 1.7.

b. Gravel—Gravel, when used as the supporting media, shall consist of hard, rounded particles and shall not include flat or elongated particles. The coarsest gravel shall be 2½ inches in size when the gravel rests directly on the strainer system, and must extend above the top of the perforated laterals or strainer nozzles. Not less than four layers of gravel shall be provided in accordance with the following size and depth distribution when used with perforated laterals or strainer nozzles:

Size	*Depth*
2½ to 1½ inches	5 to 8 inches
1½ to ¾ inches	3 to 5 inches
¾ to ½ inches	3 to 5 inches
½ to 3/16 inches	2 to 3 inches
3/16 to 3/32 inches	2 to 3 inches

(g) *Filter bottoms and strainer systems.* Departures from these standards by using proprietary bottoms may be approved on a case-by-case basis if the effectiveness of such method is demonstrated. Porous plate bottoms shall not be used where iron or manganese may clog them or with waters softened by lime. The design of manifold type collection systems shall:

1. Minimize loss of head in the manifold and laterals;
2. Assure even distribution of washwater and even rate of filtration over the entire area of the filter;
3. Provide a ratio of the area of the final openings of the strainer systems to the area of the filter of about 0.003;
4. Provide a total cross-sectional area of the laterals about twice the total area of the final openings of the strainer system;
5. Provide a cross-sectional area of the manifold at 1½ to 2 times the total cross-sectional area of the laterals.

(h) *Surface wash.* Surface wash facilities consisting of either fixed nozzles or a revolving mechanism are required. All devices shall be designed for:

1. Water pressures of at least 45 psi;
2. Volume of flow of 2.0 gpm per square foot of filter area with fixed nozzles and 0.5 gpm per square foot with revolving arms;
3. A vacuum breaker installed above the high water elevation in the filter or other approved device to prevent back siphonage.

(i) *Appurtenaces.* The following shall be provided for every filter:

1. Sampling tap on the effluent line;
2. Indicating loss-of-head gauge;
3. Indicating flow rate controls;

Note: A modified rate controller which limits the rate of filtration to a maximum rate may be used, however, equipment that simply maintains a constant water level on the filters will not be approved unless the rate of flow onto the filter is properly controlled; a pump in each filter effluent line may be used as the limiting factor for the rate of filtration only after consultation with the department.

4. Provisions for draining to waste with appropriate measures for backflow prevention;

5. A means of monitoring the effluent from each filter for turbidity on a continuous basis or on a selective basis where one turbidimeter would monitor more than one filter on a rotating cycle. Recorders shall be provided. Access to the filter interior through wall sleeves shall be provided in several locations to allow the installation of sampling lines, pressure sensors, and other devices, at different depths in the filter media;

6. A 1- to 1½-inch pressure hose and rack at the operating floor for washing the filter walls.

(j) *Backwash.* Facilities shall permit the washing of filters as follows:

1. By filtered water at a rate not less than 15 gallons per square foot per minute from washwater tanks; a washwater pump from a reservoir or a high service main, or a combination of these;

2. By washwater pumps in duplicate unless an alternate means of obtaining washwater is available;

3. By not less than 15 minutes wash of one filter at the design rate of wash;

4. By a washwater regulator or valve on the washwater line to obtain the desired rate of filter wash;

5. By a rate-of-flow indicator and totalizer on the main washwater line, located for convenient reading by the operator during the washing process;

6. By a method which prevents rapid changes in the backwash water flow.

(k) *Miscellaneous.* Roof drains shall not discharge into the filters and basins or the conduits preceding the filters.

(2) SLOW RATE GRAVITY FILTERS. The use of these filters will require prior engineering studies to demonstrate the adequacy and suitability of this method of filtration for the specific raw water supply. The following standards will be applied:

(a) *Quality of raw water.* Slow rate gravity filtration shall be limited to waters having maximum turbidities of 50 units and maximum color of 30 units; such turbidity must not be attributable to colloidal clay. Raw water quality data shall include examinations for algae.

(b) *Structural details and hydraulics.* Slow rate gravity filters shall be designed to provide:

1. Not less than 2 filter units;

2. A cover or superstructure;

3. Headroom to permit normal movement by operating personnel for scraping and sand removal operations;

4. Adequate manholes and access ports for handling of sand;

5. Filtration to waste and overflow at the maximum filter water level.

(c) *Rates of filtration.* The permissible rates of filtration shall be based on the quality of the raw water as determined from experi-

mental data. Proposed rates shall be submitted to and approved by the department.

Note: The design rate will normally be 45 to 150 gallons per day per square foot of sand area; however, rates of 150 to 230 gallons per day per square foot may be approved when effectiveness is demonstrated to the satisfaction of the department.

(d) *Underdrains.* Each filter unit shall be equipped with a main drain and an adequate number of lateral underdrains to collect the filtered water. The underdrains shall be so spaced that the maximum velocity of the water flow in the lateral underdrain will not exceed 0.75 feet per second. The maximum spacing of the laterals shall not exceed 12 feet.

(e) *Filtering material.* A minimum depth of 30 inches of filter sand, clean and free of foreign matter, shall be placed on graded gravel layers. The effective size shall be between 0.35 and 0.50 mm, and the uniformity coefficient shall not exceed 2.5.

(f) *Filter gravel.* The supporting gravel shall conform to the size and depth distribution provided for rapid rate gravity filters. (Refer to NR 111.45 (1) for requirements.)

(g) *Depth of water on filter beds.* The design shall provide a depth of at least three feet of water over the sand. Influent water shall be distributed in a manner which will not scour the sand surfaces.

(h) *Control appurtenances.* Each filter shall be equipped with:

1. A loss-of-head gauge;
2. An orifice, Venturi meter, or other suitable metering device installed on each filter to enable control of the rate of filtration;
3. An effluent pipe located at an elevation which will maintain the water level in the filter above the top of the sand.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

NR 111.46 Taste and odor control. Waterworks which are designed and constructed to provide taste and odor control must comply with any requirements stated for the following applicable method(s):

(1) CHLORINATION. Chlorination is effective for the removal of some objectionable odors. Adequate contact time shall be provided to complete the chemical reactions involved.

(2) CHLORINE DIOXIDE. Chlorine dioxide may be used in the treatment of any taste or odor which is treatable by an oxidizing compound. Provision shall be made for proper storing and handling of sodium chlorite to eliminate any danger of explosion.

(3) POWDERED ACTIVATED CARBON. (a) Powdered activated carbon may be added prior to coagulation to provide maximum contact time. Although facilities to allow the addition at several alternate points is recommended, in no case shall it be added near the point of chlorine application.

(b) The carbon shall be added as a premixed slurry or by means of a dry-feed machine if the carbon is properly "wetted".

(c) Agitation shall be applied to keep the carbon from depositing in the mixing chamber.

(d) Dust control shall be provided.

(e) The required dosage of carbon in a water treatment plant depends upon the tastes and odors involved. Provision shall be made for adding sufficient amounts to meet peak demands.

(4) GRANULAR ACTIVATED CARBON. Where granular activated carbon is proposed as a filter material, a request for approval shall be submitted to the department and shall include:

(a) An engineering report detailing raw water quality, results of pilot plant studies, proposed flow rates, process controls to be provided, proposed operational adjustments, and justification for the project proposals.

(b) Criteria for the media.

(c) Provision for a chlorine residual in the water following filtering and prior to distribution.

(d) Provision for periodic treatment of the filter bed to control possible bacterial and other growths.

(e) Plans showing any proposed modification of facilities.

(5) COPPER SULPHATE AND OTHER COPPER COMPOUNDS. Continuous or periodic treatment of water with copper compounds to kill algae or other growths shall be controlled to prevent excess copper in the plant effluent or distribution system. Provision must be made for uniform distribution of the chemical.

(6) AERATION. (See NR 111.36 for requirements.)

(7) POTASSIUM PERMANGANATE. Application of potassium permanganate may be approved by the department if the treatment will be controlled to insure that no residual color will be present in the finished water.

(8) OTHER METHODS. The decision to use any other methods of taste and odor control shall be made only after laboratory tests and approval by the department.

(9) FLEXIBILITY. Plants treating water known to have taste and odor problems shall be provided with equipment and multiple chemical addition points to provide several alternative control processes.

Note: Refer to Part 5 of this chapter, beginning with NR 111.50 for requirements for the storage, handling, and application of chemicals in treating surface waters.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

PART 5. CHEMICAL ADDITION: REQUIREMENTS FOR DESIGN AND CONSTRUCTON OF FACILITIES FOR STORAGE AND HANDLNG, DISINFECTION, FLUORIDATION AND STABILIZATION

NR 111.50 General. This part contains general requirements for the design and construction for chemical storage, handling and addition facilities. Specific operating requirements are contained in NR 111.23 (4).

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

NR 111.51 Feed equipment. (1) NUMBER OF FEEDERS. If chemical feed, such as chlorination, coagulation or other process, is necessary for the protection of the water supply, a minimum of 2 feeders shall be provided so that a standby unit or combination of units will be available to replace the largest unit during shut-downs. Spare parts shall be available for all feeders to replace parts which are subject to wear and damage.

(2) DESIGN AND CAPACITY. The design shall insure that:

(a) A separate feed system is provided for each chemical.

(b) Feeders will be able to supply, at all times, the necessary amounts of chemical at an accurate rate, throughout the range of feed. To allow for changes in pumping or application rates the feeder shall be designed to operate between 30 and 70% of the feeder range on initial start-up. If this is not possible with stock chemical solution, dilution of the chemical will be required.

(c) Proportioning of chemical feed to rate of flow is provided.

(d) Positive displacement type solution feeders shall be used to feed liquid chemicals.

(e) Chemical solutions are prevented from being siphoned into the water supply by assuring discharge at points of positive pressure and by providing anti-siphon devices, or through a suitable air gap or other effective means approved by the department.

(f) The service water supply shall be protected from contamination by chemical solutions either by equipping the supply line with backflow or backsiphonage prevention devices, or by providing an air gap of 2 pipe diameters, but not less than 3 inches, between the supply line and top of solution tank.

(g) Materials and surfaces coming in contact with chemicals are resistant to the aggressiveness of the chemical solution.

(h) Dry chemical feeders measure chemicals volumetrically or gravimetrically; provide effective dissolving of the chemical in the solution pot; provide gravity feed from solution pots, if possible; and completely enclose chemicals to prevent emission of dust to the operating room.

(i) No direct connection exists between any sewer and a drain or overflow from the feeder or solution chamber or tank.

(3) LOCATION. Chemical feed equipment shall be:

(a) Located near points of application to minimize length of feed lines;

(b) Readily accessible for servicing or repair and observation of operation;

(c) Located and have protective curbings so that chemicals from equipment failure, spillage or accidental drainage shall not enter the water in conduits, treatment or storage basins;

(d) Located above grade, except as waived by the department;

(e) Located in accordance with NR 111.53 (5) if gas feeders are used.

(4) CONTROL. (a) Feeders may be manually or automatically controlled if the water supply pumps are manually controlled. Where pumps are automatically controlled, the feeders shall be automatically controlled. In all cases, automatic control shall be capable of reverting to manual control when necessary.

(b) Feeders shall be designed and controlled to provide rates proportional to flow.

(c) Automatic chemical feed rate control in combination with residual analyzers which have alarms for critical values and recording charts may be used.

(5) SOLUTION TANKS. (See NR 111.52 on Storage & Handling)

(6) WEIGHING SCALES. Weighing scales shall be:

(a) Provided for weighing cylinders at all plants utilizing chlorine gas;

Note: Indicating and recording type scales are recommended.

(b) Required for solution feed unless comparable means for determining usage is approved by the department;

(c) Required for volumetric dry chemical feeders;

(d) Accurate enough to measure increments of 0.5% of load.

(7) FEED LINES. Feed lines shall:

(a) Be as short as possible in length of run; of durable, corrosion resistant material; easily accessible throughout entire length; protected against freezing, and readily cleanable;

(b) Slope upward from chemical source to feeder when conveying gases;

(c) Introduce corrosive chemicals in such manner as to minimize potential for corrosion;

(d) Be designed consistent with scale-forming or solids-depositing properties of the water, chemical, solution or mixture conveyed;

(e) Not carry chlorine gas beyond the chlorine feeder room; and

(f) Include an injection nozzle when application is into a pipe line.

(8) SERVICE WATER SUPPLY. Water used for dissolving dry chemicals, diluting liquid chemicals or operating chemical feeders shall be from a safe, approved source with appropriate backflow prevention provided. The department may grant an exception in cases where the finished water quality will not be affected by addition of the chemical mixed with untreated water.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

NR 111.52 Storage and handling. The following are general requirements. For specific requirements refer to the section in this part covering the particular chemical.

(1) STORAGE FACILITIES. (a) Space shall be provided for at least 30 days of chemical supply; convenient and efficient handling; dry storage conditions; and a minimum of 1½ truck loads storage volume where purchase is by truck load.

(b) Covered or unopened shipping containers shall be provided for storage unless the chemical is transferred into an approved covered storage unit. Solution tanks shall have overlapping covers.

(c) Solution storage or day tanks supplying feeders directly shall have sufficient capacity for one day of operation. Where the chemical solution is prepared from a powder or slurry, two solution tanks will be required if necessary to assure continuity of feed.

(d) Storage facilities shall be constructed of, or lined with, materials compatible with the chemical being handled.

(e) Mixing equipment shall be provided where necessary to assure a uniform chemical solution strength.

(f) Means shall be provided to accurately determine the amount of chemical applied either by measurement of the solution level in the tank or by weighing scales. A meter shall be provided on the water fill line to a fluoride saturator.

(g) Liquid chemical storage tanks shall have a liquid level indicator.

(h) Adequate means of draining tanks shall be provided, but there

shall be no direct connection between any drain piping and a sewer. Drain piping shall terminate at least 2 pipe diameters, but not less than 3 inches, above the overflow rim of a receiving sump, conduit or waste receptacle.

(i) Overflow pipes shall be turned downward, be appropriately screened, have a free discharge, and be in a conspicuous location.

(j) Where subsurface locations for solution or storage tanks are necessary, the tanks shall be free from sources of possible contamination and located to assure positive drainage for groundwater, accumulated water, chemical spills and overflows.

(k) The design shall insure that incompatible chemicals are not stored or handled in common areas.

(l) Gases from feeders, storage, and equipment exhausts shall be conveyed to the outside atmosphere above grade and remote from air intakes. Acid storage tanks shall be vented to the outside but not through vents in common with day tanks.

Note: Consult local and state safety codes for other safety requirements.

(2) HANDLING FACILITIES. (a) Equipment shall be included for measuring quantities of chemicals used to prepare feed solutions.

(b) Piping for chemicals shall be compatible with the chemical being conveyed.

(c) Facilities for washing of the face and eyes, gloves and protective equipment shall be provided in the immediate area where chemicals are handled or mixed. Rubber gloves, protective clothing and goggles shall be provided for each operator who prepares chemical solutions. In addition, a dust respirator of a type approved by the U. S. bureau of mines for toxic dusts shall be provided for handling dry chemicals.

(d) Provision shall be made for the transfer of dry chemicals from shipping containers to storage bins or hoppers in such a way as to minimize dust. Control should be provided by use of one of the following:

1. Vacuum pneumatic equipment or closed conveyor systems;
2. Facilities for emptying shipping containers in special containers;
3. Exhaust fans and dust filters which place the hoppers or bins under negative pressure.

(e) Carts, elevators or other appropriate means shall be provided for lifting chemical containers to minimize lifting by operators.

(f) Electrical equipment shall be used which will prevent explosions, particularly when using sodium chlorite and activated carbon. Equipment shall comply with the National Fire Code, Volume 5, Electrical. A copy of Volume 5 (1973–1974) of the Fire Code is available for inspection at the office of the department of natural resources, the secretary of state's office and the office of the revisor of statutes, and may be obtained for personal use from the National Fire Protection Association, 470 Atlantic Ave., Boston, Mass. 02210.

(g) Procedures for disposing of empty bags, drums or barrels shall minimize exposure to dusts or chemicals.

(h) Acids shall be kept in closed, acid-resistant shipping containers or storage units. Transfer from shipping containers to solution or day tanks should be through suitable hose or pipe by means of a transfer pump.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

NR 111.53 Disinfection. Chlorine is the principal disinfecting agent used at the present time; other agents will be approved by the department on a case-by-case basis providing reliable feeding equipment is available and testing procedures for a residual are recognized in the latest edition of *Standard Methods for the Examination of Water and Wastewater* (1971). A copy of this publication is available for inspection at the office of the department of natural resources, the secretary of state's office and the office of the revisor of statutes, and may be obtained for personal use from the American Public Health Association, 1015 Eighteenth St., N.W., Washington, D.C. Disinfection will be required at all surface water supplies and at any ground water supplies where required to maintain water quality. The following standards shall be applied:

(1) EQUIPMENT. (a) *Type.* Solution-feed-gas-type chlorinators and hypochlorite feeders of the positive displacement type may be used.

(b) *Capacity.* The chlorinator capacity shall be such that a free chlorine residual of at least 2 mg/1 can be attained in the water after a contact time of at least 30 minutes when maximum flow rates coincide with anticipated maximum chlorine demands. The equipment shall be designed to operate accurately over the desired feed range.

(c) *Standby Equipment.* Where chlorination is necessary for protection of the water supply, standby equipment of sufficient capacity shall be available to replace the largest unit during shut-downs.

(d) *Automatic Proportioning.* Automatic proportioning chlorinators will be required where the rate of flow is not reasonably constant or where the rate of flow of the water is not manually controlled.

(2) CONTACT TIME AND POINT OF APPLICATION. Chlorine shall be applied at a point which will provide the maximum contact time, not less than one half hour in cases where suspended solids have been removed. Provisions shall be made to minimize short-circuiting. At plants treating surface water, piping provisions shall be made for applying chlorine to the raw water, settled or clarified water, filtered water and the plant effluent. At plants treating ground water, provision shall be made for applying chlorine to the raw water and the clearwell inlet or the high-lift pump discharge piping.

(3) RESIDUAL TESTING EQUIPMENT. The equipment shall enable measurement of residuals to the nearest 0.1 mg/1 in the range below 0.5 mg/1 and to the nearest 0.2 mg/1 between 0.5 mg/1 to 2.0 mg/1.

Note: Automatic chlorine residual pacers and recorders are recommended where the chlorine demand varies appreciably over a short period of time.

(4) CHLORINATOR PIPING. The water supply piping shall be designed to prevent contamination of the treated water supply by sources of impure or unknown quality.

(5) HOUSING. Chlorine gas feed and storage shall be:

(a) Separated from other operating areas by gas-tight enclosures in order to prevent injury to personnel and damage to equipment;

(b) Provided with an inspection window installed in an interior wall or exterior door to permit viewing of the interior of the room and the equipment;

(c) Provided with doors having emergency or panic hardware and opening outward to the building exterior if possible;

(d) Heated to prevent freezing and insure proper operation of the equipment;

(e) Provided with restraints to prevent movement of the chlorine cylinders;

(f) Designed so that the ejector for mixing chlorine gas and water is located in the chlorine room.

(6) VENTILATION OF CHLORINE ROOMS. One complete air change per minute shall be provided when the room is occupied, and:

(a) The exhaust fan suction shall be near the floor with the point of discharge located to avoid contamination of air inlets to other rooms and structures or being blocked by snow, or other obstructions;

(b) Air inlets shall be located near the ceiling and controlled to prevent adverse temperature variations;

(c) The exhaust fan switch shall be located at the entrance to the chlorine room with a signal light indicating fan operation provided when the fan can be controlled from more than one point;

Note: It is recommended that switches for fans and lights be interlocked for simultaneous operation.

(d) Vents from feeders and storage shall discharge to the outside atmosphere, above grade as indicated in paragraph (a) above.

(7) AMMONIATION. Housing and ventilation shall be as stated in subsection (5) and (6) above for chlorine. Ammonia storage and feed facilities shall be separate from chlorine facilities because of the combustion hazard. A plastic bottle of hydrochloric acid shall be available and used for leak detection.

(8) SAFETY EQUIPMENT. The following equipment shall be provided when chlorine gas is used.

(a) At least one gas mask in good operating condition of the type having a self-contained supply of air such as that approved by the U. S. bureau of mines as suitable for high concentrations of chlorine gas. The masks shall be available at all installations where chlorine gas is handled and shall be placed outside every room where chlorine gas is used or stored. At installations utilizing 100- or 150-pound cylinders, an agreement with the local fire department which has an approved type of gas mask may satisfy the requirement. Instructions for using, testing and replacing mask parts shall be posted. Other protective clothing shall be provided as necessary.

(b) A plastic bottle of ammonium hydroxide for leak detection.

Note: At larger plants where ton cylinders are used, the installation of automatic gas detection and related alarm equipment is recommended.

(c) Where ton cylinders are used, leak repair kits shall be available at the water works or a nearby fire department.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

NR 111.54 Fluoridation. The following specific requirements shall be met:

(1) FLUORIDE COMPOUND STORAGE. Compounds shall be stored in covered or unopened shipping containers. Permanent storage units for hydrofluosilicic acid should be vented to the atmosphere at a point outside the building.

(2) DRY CONVEYORS. Design shall provide for transfer of dry fluoride compounds from shipping containers to storage bins or hoppers in such a way as to minimize the quantity of fluoride dust.

(3) CHEMICAL FEED INSTALLATIONS. Chemical feed installations shall:

(a) Conform to the requirements in sections NR 111.50 through NR 111.53.

(b) Provide scales, loss-of-weight recorders or graduated feed drums for determining the amount of chemical applied. A meter shall be provided on the water fill line to a fluoride saturator.

(c) Have an accuracy which insures that actual feed will be within five percent of that prescribed.

(d) Be such that the point of application of hydrofluosilicic acid, if into a horizontal pipe, shall be in the lower half of the pipe with the nozzle projecting upward.

(e) Be such as to provide a minimum of 12 injections per minute at the feeding rate where fluoride is being added to water being pumped directly to the distribution system.

(f) Provide adequate anti-siphon devices for all fluoride feed lines.

(g) Provide soft water for fluoride saturator makeup water.

(4) PROTECTIVE EQUIPMENT. Protective clothing, gloves, goggles or face shields, and aspirator shall be provided if applicable.

(5) TESTING EQUIPMENT. Equipment shall be provided for measuring the quantity of fluoride in the water. Equipment utilizing the SPADNS or electrode method is required. The Alizarin Visual method will be approved only in special cases where the owner can allocate the extra time needed for testing.

(6) DILUTION EQUIPMENT. Where dilution of the chemical solution is necessary, a graduated container and transfer pump shall be provided.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

NR 111.55 Stabilization. Water that is unstable to the extent of causing corrosion or deposition problems in the distribution system, whether a result of natural causes or to treatment given the water, shall be stabilized. The following standards shall apply:

(1) CARBON DIOXIDE ADDITION. (a) Recarbonation chamber design shall provide detention for 3 to 10 minutes; a depth of about 8 feet; and a reaction tank with detention of 20 minutes.

(b) The design shall prevent the possibility of carbon monoxide entering the plant from the recarbonation and reaction chamber.

(2) POLYPHOSPHATES. Polyphosphates may be used for sequestering calcium in lime softening and stabilization of corrosive water (See NR 111.36 (2) for iron and manganese control). When used:

(a) Feed equipment shall conform to requirements in NR 111.50 through NR 111.53;

(b) Phosphate chemicals shall be certified by the U. S. department of agriculture as food grade;

(c) Stock phosphate solution shall be kept covered and disinfected by carrying approximately 10 mg/1 chlorine residual;

(d) Facilities shall be included to maintain satisfactory chlorine residuals as indicated in NR 111.23;

(e) Phosphate concentration shall not exceed 10 mg/1 as PO_4.

(3) "SPLIT TREATMENT". If approved by the department, a lime-soda water treatment plant can be designed using "split treatment" in which raw water is blended with lime-treated water to partially stabilize the water. However, treatment plants designed to utilize "split treatment" shall contain facilities for further stabilization by other methods.

(4) ALKALI FEED. An alkali feeder shall be provided for all ion exchange water softening plants to provide stable water. Other waters may also be corrosive and require pH adjustment. The chemical shall be adequately mixed and the point of application located such that any deposition in the piping is minimized. The piping shall be accessible for cleaning or replacement. Equipment for monitoring pH shall be provided.

(5) OTHER. Other chemical compounds may be approved by the department on a case-by-case basis if their effectiveness is demonstrated by testing or other studies.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

PART 6. STORAGE FACILITIES: REQUIREMENTS FOR DESIGN AND CONSTRUCTION

NR 111.60 Volume and pressure. (1) SIZING. A sufficient quantity of water, as determined from engineering studies, shall be maintained in elevated storage when only one pumping unit to the distribution system is available to serve the water system. This shall be at least a one-day supply under normal operating conditions. When more than one distribution pump is available, the storage shall be in accordance with standard engineering practice. The requirement for elevated storage may be waived by the department in cases where the system is designed to serve less than 50 homes; where it is not economically feasible to provide elevated storage; where elevated storage facilities are proposed for a later development phase; or where service is proposed for domestic use only.

(2) PUMPING FACILITIES. If no elevated storage is available, and more than 50 homes are to be served, 2 or more pumping units shall be provided, each of which can supply the normal daily demands. An approved interconnection with another water system or ground storage with booster pumps may be used in lieu of this requirement. A hydro-pneumatic tank or other reliable means shall be provided to maintain system pressure when an elevated tank is not available.

Note: See NR 111.35 for hydro-pneumatic tank requirements.

(3) PRESSURE REQUIREMENTS. The storage facilities shall be designed to meet the minimum and maximum pressure requirements specified in NR 111.64 and, in conjunction with distribution system design, provide flows as specified in NR 111.71.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

NR 111.61 Location. (1) Storage facilities shall not be located within a flood plain.

(2) The area surrounding structures shall be graded in a manner that will prevent surface water from standing within 50 feet of the structure.

Note: It is recommended that the bottom of ground level reservoirs and standpipes be placed at the normal ground surface.

(3) Where the bottom must be below normal ground surface, it shall be placed above the groundwater table. Sewers, drains, standing water, and similar sources of contamination shall be kept at least 50 feet from the reservoir. Water pipe, pressure tested in place to 50 psi without leakage, may be used for gravity sewers at lesser separations if approved by the department.

(4) The top of a ground level reservoir shall not be less than 2 feet above normal ground surface. Clearwells constructed under filters may be excepted from this requirement when the total design gives the same protection.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

NR 111.62 Construction details. (1) MATERIALS. The materials and designs used for finished water storage structures shall provide stability and durability as well as protect the quality of the stored water. Unless the design engineer can justify the use of other materials, only steel or concrete will be approved for use in a water storage facility. Steel structures shall follow the current American Water Works Association standards concerning steel tanks, standpipes, reservoirs and elevated tanks wherever they are applicable.

(2) PROTECTION. All new finished water storage structures shall have watertight roofs or covers which exclude birds, animals, insects and dust. Locks on access manholes and any other necessary measures shall be provided to prevent trespassing, vandalism and sabotage.

(3) DRAINS. Piping used to drain water from a water storage structure shall not have a direct connection to a sanitary sewer. Connection to a storm sewer may be approved on a case-by-case basis by the department.

Note: It is recommended that foundation drains which discharge to the ground surface or a storm sewer be provided.

(4) OVERFLOW. The overflow pipe of a water storage structure shall be brought down to within 12 inches of the ground surface and discharged over a drainage inlet structure or a splash plate. No overflow shall be connected directly to a sewer or storm drain. In addition:

(a) When an internal overflow pipe is used on elevated tanks, it must be located in the access tube. For vertical drops on other types of storage facilities, the overflow pipe must be located on the outside of the structure.

(b) The overflow of a ground level structure shall terminate a minimum of 12 inches above normal or graded ground surface, and the pipe shall open downward over a splash pad. The overflow shall be screened with twenty-four mesh noncorrodible screen installed within the pipe at a location least susceptible to damage by vandalism.

(c) The overflow pipe shall be of sufficient diameter to permit waste water in excess of the filling rate.

(5) ACCESS. Finished water storage structures shall be designed

with convenient access for cleaning and maintenance. Manholes above the waterline shall be:

(a) Framed at least 4 inches above the surface of the roof at the opening; on ground level structures manholes shall be elevated no less than 24 inches above the top or covering sod.

(b) Fitted with a solid watertight cover which overlaps the framed opening and extends down around the frame at least 2 inches.

(c) Locked at all times except when being used by authorized personnel.

(6) VENTS. Finished water storage structures shall be constructed with special vent structures. Open construction between the sidewall and roof is not permissible. Vents shall:

(a) Prevent the entrance of surface water;

(b) Exclude birds and animals;

(c) Exclude insects and dust to the extent this can be done while providing effective venting.

Note: For elevated tanks and standpipes, four-mesh noncorrodible screen may be used.

(d) Terminate, on ground level structures, in an inverted U construction with the opening 24 to 36 inches above the roof or sod and covered with twenty-four mesh noncorrodible screen installed within the pipe at a location least susceptible to vandalism.

(7) SILT STOP. The discharge pipes from all reservoirs shall be located in a manner that will prevent the flow of sediment into the distribution system. Removable silt stops will be required where feasible.

(8) ROOF AND SIDEWALL. The roof and sidewalls of all structures must be watertight with no openings except vents, manholes, overflows, risers, drains, pump mountings, control ports, or piping for inflow and outflow. Buried or partially buried structures shall have a waterproof membrane applied. In addition:

(a) Any pipes running through the roof or sidewall of a finished water storage structure shall be welded or properly gasketed in metal tanks, or be connected to standard wall castings which were poured in place during the formation of a concrete structure; these wall castings shall have seepage rings embedded in the concrete.

(b) Openings in a storage structure roof or top, designed to accommodate control apparatus, pump columns, and other equipment, shall be curbed and sleeved with proper additional shielding to prevent the access of surface or floor drainage water to the structure.

(c) Valves and controls shall be located outside the storage structure so that valve stems and similar projections will not pass through the roof or top of the reservoir unless the department determines that this requirement need not be met to fulfill the other requirements of this chapter.

(9) DRAINAGE FOR ROOF OR COVER. The roof or cover of the storage structure shall be well drained, but downspout pipes shall not enter or pass through the reservoir. Parapets, or similar construction which would hold water and snow on the roof, will not be approved unless adequate waterproofing and drainage is provided.

(10) SAFETY. The safety of employees shall be considered in the

design of the storage structure. The following safety measures shall be provided:

(a) Ladders, ladder guards, balcony railings, and safe location of entrance hatches be provided where applicable.

(b) On elevated tanks where persons must transfer from the access tube to the water compartment, railings or handholds be provided.

(c) Elevated tanks with riser pipes over 8 inches in diameter should have protective bars over the riser openings inside the tank.

Note: Reference should be to applicable local and state codes for specific requirements.

(11) FREEZING. All finished water storage structures and their appurtenances shall be designed to minimize freezing which would interfere with proper functioning.

Note: This requirement is especially important for riser pipes, overflows and vents.

(12) INTERNAL CATWALK. Every catwalk over finished water in a storage structure shall have a solid floor with raised edges to prevent shoe scrapings and dirt from falling into the water.

(13) PAINTING AND CATHODIC PROTECTION. Metal surfaces shall be protected by paints or other protective coatings, or by cathodic protective devices. Paint systems must be consistent with current American Water Works Association standard D102 (February 11, 1964) and approved by the department. Cathodic protection shall be designed and installed by competent technical personnel. A copy of the cited standards are available for inspection at the office of the department of natural resources, the secretary of state's office and the office of the revisor of statutes, and may be obtained for personal use from the American Water Works Association, 6666 West Quincy Ave., Denver, Colorado 80235.

(14) MISCELLANEOUS. A smooth end sampling tap and a threaded tap for chlorination purposes shall be installed in the connecting main or riser pipes of elevated tanks, standpipes and reservoirs if design permits.

Note: Obstacle lights at the top of standpipes and elevated tanks may be required by the federal aviation agency.

(15) DISINFECTION. Finished water storage structures shall be disinfected before being put into service. Detailed procedures for disinfection, equivalent to those outlined in the current American Water Works Association Standard D102 (February 11, 1964) for painting and repairing steel tanks, standpipes, reservoirs, and elevated tanks, shall be written into the specifications by the designing engineer. Refer to NR 111.23 (3) for disinfection and sampling requirements. A copy of the cited standard is available for inspection at the office of the department of natural resources, the secretary of state's office and the office of the revisor of statutes, and may be obtained for personal use from the American Water Works Association, 6666 West Quincy Ave., Denver, Colorado 80235.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

NR 111.63 Plant storage. The applicable design standards of sections NR 111.61 and NR 111.62 shall be followed for plant storage. In addition:

(1) WASHWATER TANKS. Washwater tanks shall be sized, in conjunction with available pump units and finished water storage, to provide the backwash water required by section NR 111.45 (j).

Note: Consideration should be given to the possibility of having to wash more than one filter at a time, or several filters in succession.

(2) CLEARWELL. (a) Clearwell storage shall be sized, in conjunction with distribution system storage, to relieve the filters from the pressure of fluctuations in water use or peak demands.

(b) When finished water storage is used to provide proper contact time for disinfection, special attention shall be given to size and baffling. (See NR 111.53 for disinfection requirements).

(3) ADJACENT COMPARTMENTS. Finished water shall not be stored or conveyed in a compartment adjacent to unsafe water when the two compartments are only separated by a single wall.

(4) BASINS AND WET-WELLS. Receiving basins and pump wet-wells for finished water shall be designed as finished water storage structures.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

NR 111.64 Distribution system storage. The applicable design standards of sections NR 111.61 and NR 111.62 shall be followed for distribution storage. In addition:

(1) PRESSURE VARIATION. The normal variation between high and low levels in storage structures which float on a distribution system shall not exceed 30 feet. The minimum and maximum pressure shall be 35 and 100 psi respectively. In areas where this pressure cannot be maintained, it will be necessary to establish a high pressure zone in the distribution system by means of booster pumps and related facilities or pressure boosting systems on individual service lines. When static pressures exceed 100 psi, pressure reducing devices may be required on mains in the distribution system.

Note: Refer to 111.74 for booster pump requirements.

(2) DRAINAGE. The design shall provide draining of storage facilities for cleaning or maintenance without causing loss of pressure in the distribution system. The drains shall discharge to the ground surface with no direct connection to a sewer or storm drain.

(3) LEVEL CONTROLS. Adequate controls shall be provided to maintain required levels in distribution system storage structures. Level indicating devices shall be provided at a central location.

Note: Combination indicating and recording devices are recommended.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

PART 7. DISTRIBUTION SYSTEMS: REQUIREMENTS FOR DESIGN AND CONSTRUCTION

NR 111.70 Materials. All pipe used for water main installations shall be cast iron, ductile iron, steel, reinforced concrete, asbestos-cement, copper or materials specially approved by the department for restricted or experimental use. Where a restricted or experimental use approval is issued, the department may require special precautions until such time as a satisfactory use record has been established. Pipes, joints, fittings, valves and fire hydrants shall have

been manufactured in conformity with the latest standards issued by the American Water Works Association and shall be approved by the department. (The latest standards are those which are effective on the effective date of these rules). A copy of the A.W.W.A. standards are available for inspection at the office of the department of natural resources, the secretary of state's office and the office of the revisor of statutes, and may be obtained for personal use from the American Water Works Association, 6666 West Quincy Ave., Denver, Colorado, 80235.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

NR 111.71 System design—general. (1) MINIMUM WATER MAIN SIZE. The minimum size of main for providing water for fire protection and for serving fire hydrants shall be 6-inch diameter. Larger mains shall be required if necessary to allow the withdrawal of the required fire flow while maintaining a minimum residual pressure of 20 psi within the main. The minimum flow requirement for water mains serving fire hydrants is 500 gpm at 20 psi residual pressure. All water mains, including those not designed to provide fire protection, shall be sized after a hydraulic analysis based on flow demands and pressure requirements. The minimum residual pressure in the main during peak demand periods shall be 20 psi.

Note: See appropriate sections of Wisconsin Administrative Code H 62 and PSC 185 for guidance in sizing mains to provide domestic service only to residential and other type customers.

(2) DEAD ENDS. Dead ends shall be minimized by looping mains whenever possible. Where dead-end mains occur, they shall terminate with a fire hydrant, if flow and pressure are sufficient, or with an approved flushing hydrant or blow-off for flushing purposes. No flushing device shall be directly connected to any sewer.

(3) VALVING. Sufficient valves shall be provided on water mains so that inconvenience or sanitary hazard to water users will be minimized during maintenance and construction. Valves shall be located at not more than 500-foot intervals in commercial districts and at no more than one block or 800-foot intervals in other districts.

(4) FRICTION COEFFICIENTS. Unless other values are specially approved by the department, the following "C" values, using the Hazen–Williams formula, shall be used by department personnel for checking the hydraulic characteristics of new water mains shown on plans and specifications submitted for review:

Cement-lined iron and asbestos-cement pipes	C = 120
Non-cement lined iron	C = 100

Note: The "C" value of existing water mains is likely to be substantially less than that for new pipe and should be considered in distribution system analysis.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

NR 111.72 Hydrants. (1) LOCATION. Hydrants shall be provided at each street intersection and at intermediate points between intersections as recommended by the insurance services office of Wisconsin. Generally hydrant spacing may range from 350 to 600 feet depending on the area being served.

Note: The Insurance Services Office is located at 615 East Michigan, Milwaukee, Wisconsin, 53202.

(2) SIZE. Fire hydrants shall have a bottom valve size of at least 5 inches, one 4½-inch pumper nozzle, and two 2½-inch nozzles unless the waterworks has established other hydrant criteria which are in accordance with the recommendations of the insurance services office of Wisconsin. The connecting main between the supply main and the hydrants shall be a minimum of 6 inches in diameter.

(3) RESTRICTIONS. Fire hydrants shall not be installed on proposed water mains which will not have minimum flow and pressure as required in NR 111.71 (1) except that the department may approve the installation of hydrants if system improvements which will make at least 500 gpm available at 20 psi are planned for construction within one year following construction of the proposed improvements. If the exception is granted, fire department pumpers shall not be connected to the hydrants until the necessary additional improvements are made and fire flow tests have shown that greater than minimum flow and pressure are available.

(4) DRAINS. Hydrant drains shall not be connected to, or located within 8 feet of sanitary sewers or storm drains. Hydrant drain ports shall be plugged prior to installation and the barrels pumped dry during freezing weather in areas where ground water rises above the drain port. Where hydrant drain ports are not plugged, a gravel pocket or dry well shall be provided unless the department finds that the natural earth will provide adequate drainage.

(5) MISCELLANEOUS. Auxiliary valves shall be installed in hydrant leads off transmission mains and mains in commercial districts.

Note: It is recommended that auxiliary valves be installed in all hydrant leads. Also, hydrants of the type that remain closed when the barrels are broken off are recommended.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

NR 111.73 Air-relief facilities and valve and meter chambers. (1) AIR-RELIEF FACILITIES. Water mains shall, where possible, be laid to avoid high points at which air can accumulate. When high points cannot be avoided, measures shall be taken to remove the air when the main is initially filled with water. Automatic air-relief valves shall not be used in situations where flooding of the manhole or chamber may occur. The open end of an air-relief pipe shall be extended to the top of a manhole or chamber and have a screened, downward facing elbow.

(2) CHAMBERS. Chambers, pits and manholes containing valves, blow-offs, meters, or other such appurtenances to a distribution system, shall not be connected directly to any storm drain or sanitary sewer, nor shall any blow-offs or air-relief valves be connected directly to any sewer. Such chambers shall be drained to absorption pits underground or to the ground surface where they are not subject to flooding by surface water.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

NR 111.74 Booster pumping facilities in the distribution system. Where the storage or primary pumping facilities cannot provide adequate pressures throughout the distribution system, it shall be necessary to install additional pumps to serve portions of the system. Design shall be in accordance with the following:

Note: It is recommended that these pumps take suction from a reservoir.

(1) The booster pumps shall maintain static pressures in the area served within the range of 35 to 100 psi.

(2) The on-off operation of the pumps and the system pressure at the booster pump station shall be monitored at one of the main waterworks pumping stations or other waterworks facility. A continuous recording pressure device should be provided. Pressure gauges shall be provided on the suction and discharge lines. At stations serving less than 50 homes, monitoring may be provided by a light or an audible alarm placed in a conspicuous location to indicate pump failure.

(3) The pump capacities for domestic service only shall be as set forth in Figure No. 2, Part 3, of this chapter. Fire protection shall be provided where feasible and will require additional engineering studies.

(4) For pumps not directly supplied by a reservoir, the suction pressure shall be at least 35 psi when the pumps are in normal operation. An automatic cutoff control shall be provided that will stop the pumps when the suction pressure falls below 20 psi.

(5) Underground installations shall be permitted only if gravity drainage of large volumes of water from the vault can be provided or if the pumps and drivers are protected from damage by water or can be readily replaced. In-line submersible pumps may be installed below ground surface but shall be accessible for servicing and repairs. Electrical equipment shall be installed above ground except in cases where determined unnecessary by the department to meet the other requirements in this chapter.

(6) Dual pumps shall be provided, each of which can meet the peak demand, if more than 50 connections are being served. For more than 50 connections, an emergency power source or elevated storage shall also be provided.

(7) The design shall provide for automatically bypassing the pumping station when the pump is not operating. In cases where the primary system cannot provide positive pressures in all areas served by the booster pumps, storage facilities shall be required in the booster system.

(8) A meter shall be provided, if practical, in the discharge line.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

NR 111.75 Installation of mains. The installation of mains specifications shall include provisions for the following:

(a) Bedding shall be provided for all buried pipe. Backfill shall be tamped in layers around the pipe and to a sufficient height above the pipe to adequately support and protect the pipe.

(b) Stones found in the trench shall be removed for a depth of at least 6 inches below the bottom of the pipe.

(c) Pressure testing of the installed pipe, including measurement of leakage.

(d) Disinfection, flushing and bacteriological sampling procedures. (See NR 111.23 for requirements.)

(e) Sufficient earth or other suitable cover over mains to prevent freezing. A minimum cover of 5 to 7 feet is required unless determined by the department to be unnecessary in specific cases. Insulation may be required at some installations to prevent freezing. The department will notify owners when this is necessary.

(f) All tees, bends, plugs and hydrants shall be provided with reaction backing, tie rods or joints designed to prevent movement.

(g) Reference should be made to American Water Works Association standards or manufacturer's recommended installation procedures. Copies of the A.W.W.A. standards are available for inspection at the office of the department of natural resources, the secretary of state's office and the office of the revisor of statutes, and may be obtained for personal use from the American Water Works Association, 6666 West Quincy Ave., Denver, Colorado, 80235.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

NR 111.76 Separation of water mains and sewers. (1) GENERAL. The following factors shall be considered in planning separation of mains and sewers: materials and type of joints for water and sewer pipes, soil conditions, service and branch connections into the water main and sewer line, compensating variations in the horizontal and vertical separations, space for repair, and alterations of water and sewer pipes.

(2) HORIZONTAL SEPARATION.Water mains shall be laid at least 8 feet horizontally from any existing or proposed sewer. The distance shall be measured center to center. In cases where it is not practical to maintain an 8-foot separation, the department may allow deviation on a case-by-case basis, if supported by data from the design engineer. Such deviation may allow installation of the water main closer to a sewer, provided that:

(a) The bottom of the water main is at least 18 inches above the top of the sewer and the minimum horizontal separation is 3 feet measured edge to edge. (See Figure 4.)

(b) A profile of the rock surface as determined from exploration is shown on the plan when high bedrock is the reason for the variance from the 8-foot separation.

(3) VERTICAL SEPARATION. Whenever water mains cross over sewers, the water main shall be laid at such an elevation that the bottom of the water main is at least 6 inches above the top of the sewer. Whenever water mains cross under sewers, a minimum vertical separation of 18 inches shall be maintained between the top of the water main and the bottom of the sewer. At crossings, one full length of water pipe shall be centered on the sewer so that both joints will be as far from the sewer as possible. Special structural support for the water and sewer pipes may be required by the department after a determination that added support is necessary to meet the requirements of this chapter.

(4) EXCEPTION. When it is impossible to obtain the proper horizontal and vertical separation as specified in NR 111.73 (2) and (3), a gravity sanitary sewer shall be constructed of materials and with joints that are equivalent to water main standards of construction and pressure tested to assure water tightness. When the 8-foot separation distance cannot be provided for storm sewers, the horizontal and vertical separation shall be as great as practicable. The department must specifically approve any variance from the requirements in NR 111.73 (2) and (3).

(5) FORCE MAINS. No deviation from the 8-foot separation shall

be granted for sanitary sewer force main installations unless the requirement in subsection (2) (a) is met.

(6) SEWER MANHOLES. No water pipe shall pass through or come into contact with any part of a sewer manhole.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

NR 111.77 Surface water crossings. Surface water crossings, whether over or under water, present special problems. For this reason, the department must be consulted before final plans are prepared. The following are requirements:

(1) ABOVE-WATER CROSSINGS. The pipe shall be adequately supported and anchored, protected from damage and freezing, and accessible for repair or replacement.

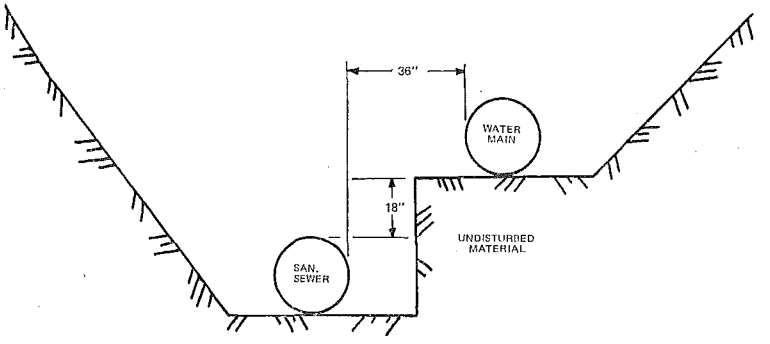
(2) UNDERWATER CROSSINGS. A minimum cover of 2 feet shall be provided over the pipe. When crossing water courses which are greater than 15 feet in width, the following shall be provided:

(a) The pipe shall be of special construction, having flexible, watertight joints.

(b) Valves shall be provided at both ends of water crossings so that the section can be isolated for testing or repair; the valves shall be easily accessible, and not subject to flooding; and the valve closest to the supply source shall be in a manhole.

(c) Permanent taps shall be made on the pipe within the manhole to allow insertion of a small meter for pressure testing to determine leakage.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.



COMMON TRENCH INSTALLATION PERMITTED IN SPECIAL CASES FOR WATER MAIN AND SANITARY SEWER. SEE NR 111.76(2)(a)

PART 8. WASTE DISPOSAL

NR 111.80 General. The discharge of pollutants from a waterworks facility into the waters of the state or into a publicly owned treatment works, as those terms are defined in section 147.015, Wisconsin Statutes, must conform to all the applicable requirements of chapter 147, Wis. Stats., and the rules adopted thereunder. Provisions shall be made for proper disposal of all wastes from waterworks facilities. Wastes may be from sanitary facilities, laboratories or treatment plants. Where new methods are proposed or the treatment results are uncertain, the department may require laboratory, pilot, or full-scale testing to establish design parameters. Sections NR 111.83 through NR 111.87 contain general standards which may be utilized in meeting the requirements of chapter 147, Wis. Stats.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

NR 111.81 Sanitary wastes. Wastes from toilet facilities shall be discharged to a sanitary sewer system. The floor elevation to a building from which there is a discharge shall be constructed at least one foot above the street and nearest sewer manhole cover elevation to prevent contamination from sewer backup. Where a sanitary sewer system is not available, an individual waste disposal facility may be approved by the department providing sufficient protection of the water source can be assured.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

NR 111.82 Floor drainage. Floor drains discharging to a sanitary sewer system may be approved if the floor is at least one foot above the street. Where there is danger of sewer backup, the installation of a gravel pocket in a well-drained area at least 50 feet from the building is required. The department will require greater separation distances where glacial drift wells are utilized as the water source.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

NR 111.83 Backwash wastewater from iron & manganese removal filters. (1) DISCHARGE TO SANITARY SEWER. A holding tank for backwash wastewater from iron and manganese removal filters shall be provided if the department determines that it is necessary to prevent overloading the sewers or sewage treatment plant.

(2) SAND FILTERS. The following requirements apply when sand filters are used to treat backwash wastewater from iron and manganese removal filters:

(a) Filters shall be designed for a rate of 35 gallons per square foot per day except where testing indicates that higher rates will not cause excessive plugging of the media and a quality effluent can be maintained. Sufficient surface area shall be provided so that during any filtration cycle the wastewater depth over the media does not exceed 2 feet. The filters shall be sized to handle the entire backwash volume from all of the filters at the treatment plant unless the filters are washed on a rotating schedule.

(b) No filter, regardless of the volume of water to be handled, shall be smaller than 100 square feet in area. Multiple units may be necessary to facilitate cleaning.

(c) The filter media shall consist of a minimum of 12 inches of sand, 3 to 4 inches of supporting small gravel or torpedo sand, and

9 inches of gravel in graded layers. All fines shall be removed from the media by washing. The filter sand shall have an effective size of 0.3 to 0.5 mm and a uniformity coefficient not exceeding 3.5.

(d) An adequate underdrainage collection system shall be provided. Provision shall be made for sampling the filter effluent.

(e) A cover shall be provided which prevents freezing during the winter months.

(f) The filter shall be located in an area not subject to flooding, and the site shall be graded to prevent ponding of surface runoff. Finished grade elevation shall be designed to facilitate maintenance, cleaning and removal or replacement of surface sand. An overflow shall not be provided.

(3) LAGOONS. Lagoons used to settle backwash wastewater from iron and manganese removal filters shall meet the following design requirements:

(a) Lagoons shall be designed with a volume which is 10 times the total quantity of wash water discharged during any 24-hour period.

(b) Lagoon length shall be 4 times the width, and the width shall be at least 3 times the depth.

(c) Adequate inlet and outlet devices shall be provided so that velocity currents are minimized.

(4) DETENTION TANKS. Detention tanks for backwash wastewater from iron and manganese removal filters shall meet the following design requirements:

(a) Detention tanks shall be designed to maximize settling by means of inlet piping and baffling configurations. Tanks shall be of sufficient capacity to hold at least two complete backwash cycles. The floor shall be sloped to a sump and access manholes provided to facilitate cleaning. A cover shall be provided to prevent freezing.

(b) Pumps shall be provided to discharge the decantate to a storm sewer or receiving watercourse over approximately a 24-hour period. A convenient means of sampling the effluent shall be provided.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

NR 111.84 Brine wastes from ion exchange plants. If permitted by the department, brine wastes may be discharged to a sanitary sewer system or to a watercourse in cases where sufficient flow is available to provide adequate dilution to meet water quality or effluent standards. Dilution in streams shall be based on the 7-day low flow for the previous 10-year period. Except when discharging to large waterways or sewerage systems which will not be overloaded by the discharge, the minimum requirement will be a holding tank of sufficient size to allow brine discharge over a 24-hour period.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

NR 111.85 Backwash wastewater from lime softening and surface water treatment plants. Where feasible, the waste filter wash water shall be returned to the inlet end of the plant at a rate of less than 10% of the raw water entering the plant. If permitted by the department, direct or controlled discharge to a sewerage system may be used if the discharge will not overload the facilities or adversely affect the treatment process. Waste filter wash water shall have the suspended solids removed before being discharged to a watercourse.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

NR 111.86 Lime softening sludge. Sludge from plants using lime to soften water will vary in quantity and in chemical characteristics depending on the softening process and the chemical characteristics of the water being softened. Following are requirements for specific disposal methods:

(1) LAGOONS. The design shall provide:

(a) Locations free from flooding, with grading or ditching to divert surface runoff.

(b) Minimum lagoon depth of 4 to 5 feet with interior and exterior slopes of 3:1.

(c) Two-years solids storage volume for temporary lagoons and 8 to 10 years storage volume for permanent lagoons.

(d) Multiple cells to provide flexibility in operation.

(e) Adjustable decanting devices.

(f) Means of convenient cleaning where appropriate.

(2) APPLICATION TO AGRICULTURAL LAND. If permitted by the department, liquid sludge may be applied to agricultural land by tank truck when the solids do not exceed 10 to 12% by weight. This method requires proper handling facilities, vehicles and equipment to permit hauling and spreading which does not create a nuisance. Adequate sludge holding facilities are required for use during times that trucks cannot operate.

(3) DISCHARGE TO SANITARY SEWER. This method may be utilized if a study or experience has shown that problems will not occur in the sewage collection system or at the sewage treatment plant. A holding tank may be necessary to even out flows to the sewer system.

(4) MECHANICAL DEWATERING. Pilot testing is necessary to show the results which may be obtained. The department will review and approve proposals on a case-by-case basis to insure that water quality and effluent requirements will be met.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.

NR 111.87 Alum or other coagulant sludge. The following methods may be considered:

(1) LAGOONS. (See NR 111.86 (1) for general design criteria.)

(2) DISCHARGE TO SANITARY SEWERS. This method may be utilized if a study or experience has shown that problems will not occur in the sewage collection system or at the sewage treatment plant. A holding tank may be necessary to even out flows to the sewer system.

(3) MECHANICAL DEWATERING. Mechanical dewatering may be utilized if approved by the department after review of the results of testing.

History: Cr. Register, November, 1974, No. 227, eff. 12–1–74.