WEST VIRGINIA SECRETARY OF STATE

KEN HECHLER

ADMINISTRATIVE LAW DIVISION

Form #2

Do Not Mark In This Box

JUN 30 4 08 PM '99

OFFICE OF WEST VIRGINIA SECRETARY OF STATE

NOTICE OF A COMMENT PERIOD ON A PROPOSED RULE

AGENCY: Division of Health, Department of Health and Human Resources TITLE NUMBER: 64

RULE TYPE: Legislative ; CITE AUTHORITY W. Va. Code §§16-1-7, -9 & -9(a)

AMENDMENT TO AN EXISTING RULE: YES ___ NO X

IF YES, SERIES NUMBER OF RULE BEING AMENDED: _____

TITLE OF RULE BEING AMENDED: _____

IF NO, SERIES NUMBER OF RULE BEING PROPOSED: 77

TITLE OF RULE BEING PROPOSED: Public Water Systems Design Standards

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IN LIEU OF A PUBLIC HEARING, A COMMENT PERIOD HAS BEEN ESTABLISHED DURING WHICH ANY INTERESTED PERSON MAY SEND COMMENTS CONCERNING THESE PROPOSED RULES. THIS COMMENT PERIOD WILL END ON July 30, 1999 AT 4:30 p.m..

ONLY WRITTEN COMMENTS WILL BE ACCEPTED AND ARE TO BE MAILED TO THE FOLLOWING ADDRESS.

Beth Marquart, Director, Regulatory Development

Department of Health & Human Resources

Capitol Complex - Building 3, Room 265

Charleston, WV 25305

THE ISSUES TO BE HEARD SHALL BE LIMITED TO THIS PROPOSED RULE.

Joan E. Ohl

Joan E. Ohl, Secretary

ATTACH A **BRIEF** SUMMARY OF YOUR PROPOSAL

$15.80

Brief Summary Of The Rule

DESIGN STANDARDS
for Public Water Systems

The proposed legislative rule, "Design Standards for Public Water Systems," will update and replace our current design standards which have been in effect since 1970. The proposed standards are compatible with the latest requirements of the federal *Safe Drinking Water Act* and will also assure that West Virginia's new public water systems will meet the latest federal and state requirements. The new standards will also permit the state to adopt new and innovative technology as it becomes available.

Statement of Circumstances
Which Require the

Public Water Systems Design Standards Rule, 64CSR77

The current design standards were promulgated in 1970. The proposed standards will meet the latest requirements of the federal *Safe Drinking Water Act* and will permit the introduction of innovative and new technology at public drinking water systems.

FISCAL NOTE FOR PROPOSED RULES

June 1998

Rule Title: Design Standards for Public Water Systems

Type of Rule: **X Legislative** **___ Interpretive** **___ Procedural**

Agency: Division of Health
Department of Health and Human Resources

Address: Capitol Complex Building #3
Charleston, WV 25305

1. Effect of Proposed Rule	ANNUAL		FISCAL YEAR		
	INCREASE	DECREASE	CURRENT	NEXT	THEREAFTER
Estimated Total Cost				$ 0	$ 0
Personal Services					
Current Expense					
Repairs & Alterations					
Equipment					
Other					
Revenue				0	0

2. Explanation of above Estimates:

There are no costs or revenues associated with this rule.

3. Objectives of this Rule:

To assist consulting engineers in the design and construction of public drinking systems and assure compliance with the federal *Safe Drinking Water Act*.

4. **Explanation of Overall Economic Impact of Proposed Rule.**

A. Economic Impact on State Government:

None.

B. Economic Impact on Political Subdivisions; Specific Industries; Specific Groups of Citizens:

None.

C. Economic Impact on Citizens/Public at Large:

Economic development will be assisted by assuring West Virginia's drinking water will meet the federal and state requirements.

Date. 7/1/98

Signature of Agency Head or Authorized Representative:

By Virginia Tucker

Joan E. Ohl, Secretary
Department of Health and Human Resources

Joan E. Ohl

QUESTIONNAIRE

(Please include a copy of this form with each filing of your rule: Notice of Public Hearing or Comment Period, Proposed Rule, and if needed, Emergency and Modified Rule.)

DATE: June 30 , 1999

TO: LEGISLATIVE RULE-MAKING REVIEW COMMITTEE

FROM: (Agency name, Address & Phone No.) Division of Health
Department of Health and Human Resources
State Capitol Complex, Building 3, Room 265, Charleston, WV 25305
Telephone: (304) 558-5598

LEGISLATIVE RULE TITLE: Public Water Systems Design Standards, 64 CSR 77

1. Authorizing statute(s) citation: WV Code Sections 16-1-9, 16-1-9a and 16-1-7

2. a. Date filed in State Register with Notice of Hearing or Public Comment Period:

June 30, 1999

b. What other notice, including advertising, did you give of the hearing?

Publication in some state newspapers of notice of the comment period on the proposed rule and its objective to update the 1970 design standards to the Safe Drinking Water Act requirements.

c. Date of Public Hearing(s) or Public Comment Period ended:

July 30, 1999

d. Attach list of persons who appeared at hearing, comments received, amendments, reasons for amendments.

Attached N/A No comments received N/A

e. Date you filed in State Register the agency approved proposed Legislative Rule following public hearing (be exact):

N/A

f. Name, title, address and phone/fax/e-mail numbers of agency person(s) to receive all written correspondence regarding this rule (please type):

Beth Marquart, Director, Office of Regulatory Development

Department of Health and Human Resources

Building 3, Room 265, Capitol Complex

Charleston, West Virginia 25305

(304) 558-5598 FAX: (304) 558-6051 bethmarquart@wvdhhr.org

g. IF DIFFERENT FROM ITEM 'f', please give Name, title, address and phone number(s) of agency person(s) who wrote and/or has responsibility for the contents of this rule (please type):

Don Kuntz, Director

Environmental Engineering Division

Department of Health and Human Resources

815 Quarrier Street, Suite 418

Charleston, West Virginia 25301 (304) 558-2981

3. If the statute under which you promulgated the submitted rules requires certain findings and determinations to be made as a condition precedent to their promulgation:

a. Give the date upon which you filed in the State Register a notice of the time and place a hearing for the taking of evidence and a general

description of the issues to be decided.

N/A

b. Date of hearing or comment period:

N/A

c. On what date did you file in the State Register the findings and determinations required together with the reasons therefore?

N/A

d. Attach findings and determinations and reasons:

Attached N/A

TITLE 64
LEGISLATIVE RULES
DIVISION OF HEALTH
DEPARTMENT OF HEALTH AND HUMAN RESOURCES

SERIES 77
PUBLIC WATER SYSTEMS DESIGN STANDARDS

FOR PUBLIC COMMENT

64CSR77

TITLE 64
LEGISLATIVE RULES
DIVISION OF HEALTH
DEPARTMENT OF HEALTH AND HUMAN RESOURCES

SERIES 77
PUBLIC WATER SYSTEMS DESIGN STANDARDS

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TITLE 64
LEGISLATIVE RULES
DIVISION OF HEALTH
DEPARTMENT OF HEALTH AND HUMAN RESOURCES

SERIES 77
PUBLIC WATER SYSTEMS DESIGN STANDARDS

§64-77-1. General.

1.1. Scope. -- The State of West Virginia provides for the regulation of public water supplies to promote and protect the public health by having the public served safe and potable water. The West Virginia Division of Health is empowered to adopt rules to implement the intent of the law.

These Design Standards have been prepared to assist professional engineers responsible for the design and construction of public water supply systems. The design of such facilities should not be limited by minimum requirements, but shall meet the needs of the particular situation. Nothing in these standards should be construed as preventing the consulting engineer from recommending, or the West Virginia Division of Health, Environmental Engineering Division, from approving, more effective treatment where local conditions dictate such action.

Reliable engineering data and a report on new and innovative technology shall be made available to the West Virginia Division of Health, Environmental Engineering Division, before approval can be granted. An experimental installation may be permitted, but should the development fail to produce results satisfactory to the Environmental Engineering Division, it shall be replaced by a conventional installation approved by the Environmental Engineering Division.

The term "shall" as used herein is intended to mean a mandatory requirement. Other terms, such as "should," "recommended," and "preferred" indicate desirable procedures or methods.

The Recommended Standards for Water Works, 1992 Edition of the Great Lakes - Upper Mississippi River Boards of State Sanitary Engineers were used as a guide for this rule.

1.2. Authority. - W. Va. Code §§16-1-9, 16-1-9a and 16-1-7.

1.3. Filing Date. -

1.4. Effective Date. -

1.5. Repeal of former rule. -- This legislative rule repeals and replaces the interpretive rule of the Division of Health, Design Standards for Public Water Supply Systems, 64CSR42,

filed October 30, 1969 and effective January 1, 1970.

1.6. Definitions.

1.6.a. AIA – American Insurance Association, 1130 Connecticut Ave. N.W., Ste. 1000, Washington, DC 20036, (202) 828-7100.

1.6.b. ANSI – American National Standard Institute, 11 W. 42nd St. 13th Floor,, New York, NY 10036, (212) 642-4900.

1.6.c. API – American Petroleum Institute, 1220 L. St. N.W., Washington, D.C. 20005, (202) 682-8000.

1.6.d. ASTM – American Society for Testing and Materials, 1916 Race St., Philadelphia, PA 19103-11878, (215) 299-5400.

1.6.e. AWWA – American Water Works Association, 6666 West Quincy Ave., Denver, CO 80235, (303) 794-7711.

1.6.f. CT – C, residual disinfectant (mg/l) x T, contact time (min).

1.6.g. ISO – Insurance Service Office, 7 World Trade Center New York, NY 10048, (212) 898-6000.

1.6.h. MF – Membrane filter.

1.6.i. MPN – Most probable number.

1.6.j. NEC – National Electric Code, Quincy, MA 02269.

1.6.k. NGWA – National Ground Water Association, 601 Dempsey Road, Westerville, OH 43081-9895, (800) 551-7379.

1.6.l. NIOSH – National Institute for Occupational Safety and Health, Appalachian Laboratory for Occupational Safety and Health, 944 Chestnut Ridge Road, Morgantown, WV 26505, (304) 291-4126.

1.6.m. NSF – National Sanitary Foundation, 3475 Plymouth Rd., P.O. Box 130140, Ann Arbor, MI 48113-0140, (313) 922-6222.

1.6.n. NTU – Nephelometric turbidity units.

1.6.o. NWSC – National Water Systems Council, 600 S. Federal St., Ste. 400. Chicago, IL 60605, (312) 922-6222.

1.6.p. PVC – Polyvinyl chloride.

1.6.q. Standard Methods for the Examination of Water and Wastewater – A joint publication of the American Public Health Association, the AWWA and the Water Pollution Control Association.

1.6.r. WSC – Water Systems Council, 600 S. Federal St., Ste. 400, Chicago, IL 60605, (312) 922-6222.

1.6.s. WVDEP – West Virginia Division of Environmental Protection, 1201 Greenbrier St., Charleston, WV 25311, (304) 558-4086.

§64-77-2. Submission of Plans.

2.1. General -- All reports, final plans and specifications should be submitted at least forty-five (45) days prior to the date on which action by the Environmental Engineering Division is desired. Permits for construction, for waste discharges, for stream crossings, etc., may be required from other federal, state or local agencies. Preliminary plans and the engineer's report should be submitted for review prior to the preparation of final plans. No approval for construction can be issued until final, complete, detailed plans and specifications have been submitted to the Environmental Engineering Division and found to be satisfactory.

2.1.a. Four complete sets of documents submitted for formal review shall include but not be limited to: a summary of the basis of design; operation requirements, where applicable; general layout; detailed plans; and specifications.

2.1.b. All installation and operations shall meet or exceed the relevant requirements of the national, state, local or trades' good practices, regulations, codes, whichever has jurisdiction.

2.2. Engineer's Report -- The engineer's report for public water systems improvements shall, where pertinent, present the following information:

2.2.a. General information, including description of the existing public water systems and wastewater facilities; identification of the municipality or area served; and the name and mailing address of the owner or official custodian;

2.2.b Extent of public water system, including description of the nature and extent of the area to be served; provisions for extending the public water system to include additional service areas; and an appraisal of the future requirements for service, including existing and potential industrial, commercial, institutional and other water supply needs;

2.2.c. Alternate plans -- Where two or more solutions exist for providing public water supply facilities, each of which is feasible and practicable, discuss the alternate plans. Give reasons for selecting the one recommended, including financial considerations, and a comparison of the minimum classifications of the public water system operators required for operation of each alternative facility;

2.2.d. Soil, groundwater conditions, and foundation problems, including a description of: the character of the soil through which water mains are to be laid; foundation conditions prevailing at sites of proposed structures, and the approximate elevation of ground water in relation to subsurface structures;

2.2.e. Water use data, including a description of the customer and population trends as indicated by available records, and the estimated population that will be served by the proposed water supply system or expanded system. Water use data shall also include present water consumption and the projected average and maximum daily demands, including fire flow demand; present and estimated yields of the sources of supply; unusual occurrences,

and unaccounted for water;

2.2.f. Water distribution. -- Normal, minimum and maximum pressures with and without fire flow at the beginning of the system, at the ends of the system and intermediate points throughout the system. Include supporting data used as basis for design;

2.2.g. Flow requirements, including hydraulic analyses based on flow demands and pressure requirements; and fire flows, when fire protection is provided, meeting the recommendations of the ISO or other similar agency for the service area involved;

2.2.h Wastewater system available -- Describe the existing wastewater system, with special reference to its relationship to existing or proposed public water system structures that may affect the location and operation of the public water system, or that may affect the quality of the supply;

2.2.i. Sources of water supply -- Describe the proposed source or sources of water supply to be developed, the reasons for their selection, and provide information as follows:

2.2.i.1. Surface water sources, including hydrological data, stream flow and weather records; safe yield, including all factors that may affect it; maximum flood flow, together with approval for safety features of the spillway and dam from the appropriate reviewing authority. Include a description of the watershed, noting any existing or potential sources of contamination (such as highways, railroads, chemical facilities, etc.) that may affect water quality. Include data on the quality of the raw water with special reference to fluctuations in quality, changing meteorological conditions, regulated contaminant levels, etc.;

2.2.i.2. Groundwater sources, including sites considered; advantages of the site selected; elevations with respect to surroundings; probable character of formations through which the source is to be developed, and geologic conditions affecting the site, such as anticipated interference between proposed and existing wells;

2.2.i.3. Summary of source exploration, test well depth, and method of construction; placement of liners or screen; test pumping rates and their duration; water a levels and specific yield; water quality;

2.2.i.4. Sources of possible contamination such as sewers and sewerage facilities, highways, railroads, landfills, outcroppings of consolidated water-bearing formations, chemical facilities, waste disposal wells, etc.;

2.2.i.5. A description and plat of the system's wellhead protection area and plan;

2.2.j. Proposed treatment processes -- Summarize and establish the adequacy of proposed processes and unit parameters for the treatment of the specific water under consideration. Alternative methods of water treatment and chemical use should be considered

as a means of reducing waste handling and disposal problems. Pilot studies should be included, if applicable;

2.2.k. Waste disposal -- Discuss the various wastes from the water treatment plant; including volume, proposed treatment and points of discharge;

2.2.l. Automation -- Provide supporting data justifying automatic equipment, including the servicing and operator training to be provided. Manual override and redundancy shall be provided for any automatic controls;

2.2.m. Personnel -- Required number of: plant operators and relief plant operators needed to provide adequate operator coverage; distribution system maintenance personnel and meter readers needed to provide adequate coverage; and clerical personnel needed to provide adequate coverage;

2.2.n. Project sites, including the discussion of the various sites considered and advantages of the recommended ones; the proximity of residences, industries, and other establishments, and any potential sources of pollution that may influence the quality of the supply or interfere with effective operation of the public water system, such as sewage absorption systems, septic tanks, privies, cesspools, sink holes, sanitary landfills, refuse and garbage dumps, etc.;

2.2.o. Financing, including estimated cost of integral parts of the system; detailed estimated annual cost of operation; and proposed methods to finance both capital charges and operating expenses; and

2.2.p. Future extensions. - Summarize planning for future needs and services.

2.3. Plans -- Plans for public water system improvements shall, where pertinent, provide the following:

2.3.a. General layout shall include: suitable title; name of the municipality, other entity or person responsible for the water system; area or institution to be served; scale; north point; datums used; boundaries of the municipality or area to be served; date, name and address of the designing engineer; the imprint of the professional engineer's seal or conformance with engineering registration requirements of West Virginia; legible prints suitable for reproduction; location and size of existing and proposed water mains; and location and nature of existing public water system structures and appurtenances affecting the proposed improvements, noted on one sheet;

2.3.b. Detailed plans shall include:

2.3.b.1. Stream crossings, providing profiles with elevations of the stream bed and the normal and extreme high and low water levels;

2.3.b.2. Profiles having a horizontal scale of not more than one hundred

(100) feet to the inch and a vertical scale of not more than ten (10) feet to the inch, with both scales clearly indicated. Profiles will not be required for water main construction, however, critical elevations (high points, low points, water tanks, booster stations, etc.) are required;

2.3.b.3. Location and size of the property to be used for the groundwater development with respect to known references such as roads, streams, section lines, or streets;

2.3.b.4. Topography and arrangement of present or planned wells or structures, with contour intervals not greater than two (2) feet;

2.3.b.5. Elevations of the one hundred (100) year flood level, the floor of the structure, upper terminal of protective casings and outside surrounding grade, using United States Coast and Geodetic Survey, United States Geological Survey or equivalent elevations where applicable as reference;

2.3.b.6. Plat and profile drawings of well construction, showing diameter and depth of drill holes, casing and liner diameters and depths, grouting depths, elevations and designation of geological formations, water levels and other details to describe the proposed well completely;

2.3.b.7. Location of all existing and potential sources of pollution that may affect the water source or underground treated water storage facilities;

2.3.b.8. Size, length, and identity of sewers, drains, and water mains, and their locations relative to plant structures;

2.3.b.9. Schematic flow diagrams and hydraulic profiles showing the flow through various plant units;

2.3.b.10. Piping in sufficient detail to show flow through the plant, including waste lines;

2.3.b.11. Locations of all chemical storage areas, feeding equipment and points of chemical application;

2.3.b.l2. All appurtenances, specific structures, equipment, water treatment plant waste disposal units and points of discharge having any relationship to the plans for water mains and public water system structures;

2.3.b.13. Locations of sanitary or other facilities, such as lavatories, showers, toilets, and lockers, when applicable or required by the Environmental Engineering Division;

2.3.b.14. Locations, dimensions, and elevations of all proposed plant facilities;

2.3.b.15. Locations of all sampling taps; and

2.3.b.16. Adequate description of any features not otherwise covered by the specifications.

2.4. Specifications -- Complete, detailed technical specifications shall be supplied for the proposed project, including: pipe, valves and other building materials; a program for keeping existing public water system facilities in operation during construction of additional facilities so as to minimize interruption of service; laboratory facilities and equipment; the number and design of chemical feeding equipment; materials or proprietary equipment for sanitary or other facilities including any necessary backflow or back-siphonage protection.

2.5. Design Criteria - A summary of complete design criteria shall be submitted for the proposed project, containing but not limited to the following: long-term dependable yield of the source of supply; reservoir surface area, volume, and a volume-versus-depth curve, if applicable. The summary shall include area of watershed, if applicable; estimated average and maximum day water demands for the design period; number of proposed services; fire fighting requirements; flash mix, flocculation and settling basin capacities; retention times; unit loadings; filter area, proposed filtration rate, and filter media; backwash rate; feeder capacities and ranges, and disinfection facilities and CT calculations, where applicable. The summary shall include special facilities such as aerators, corrosion control, softeners, fluoridation, iron and manganese removal, taste and odor control. Summary shall include design calculations, including head loss, distribution system analysis and pressures at all high and low points under all flow conditions (normal flow, maximum design flow and normal flow with fire flow).

2.6. Revisions to Approved Plans -- The applicant shall obtain approval from the Environmental Engineering Division before any deviation is made from approved plans or specifications. Revised plans or specifications shall be submitted in time to permit the review and approval of such plans or specifications before any construction work, which will be affected by such changes, is begun.

2.7. Additional Information Required -- The Environmental Engineering Division may require additional information that is not part of the construction drawings, such as proprietary technical data, copies of deeds, copies of contracts, etc.

§64-77-3. General Design Considerations.

3.1. General -- The design of a public water system or treatment process encompasses a broad area. Application of this part is dependent upon the type of system or process involved.

3.2. Design Basis -- The system including the water source, treatment facilities, operation and distribution system shall be designed for maximum day demand at the design year. In general it is recommended that a system less than or equal to one (1.0) million gallons per day be designed to produce water in an eight (8) hour period or less.

3.3. Plant Layout -- Design shall consider: functional aspects of the plant layout, including provisions for future plant expansion; provisions for expansion of the plant waste treatment and disposal facilities, including filter backwash effluent; access roads; site grading; site drainage; walks; driveways; and chemical delivery and storage.

3.4. Building Layout -- Design shall provide for: adequate ventilation, lighting, heating and drainage; dehumidification equipment, if necessary; accessibility of equipment for operation, servicing, and removal; flexibility of operation; operator safety; convenience of operation. Design shall also provide for: chemical storage and feed equipment in a separate room to reduce hazards and dust problems; and an area designated for fluoridation for all systems serving five hundred (500) or more persons.

3.5. Location of Structures -- The West Virginia Division of Environmental Protection (WVDEP) shall be consulted regarding any structure that is so located that normal or flood stream flows may be impeded. Where practical, all structures shall be located above the one hundred (100) year flood elevation or have adequate protection against one hundred (100) year floods. The U.S. Army Corps of Engineers may require permits.

3.6. Electrical Controls -- Main switch gear electrical controls shall be located above grade, in areas not subject to flooding.

3.7. Standby Power -- Standby power may be required by the Environmental Engineering Division so that water may be treated or pumped, or both, to the distribution system during power outages to meet the average day demand.

3.8. Shop Space and Storage -- Adequate facilities should be included for shop space and storage consistent with the designed facilities.

3.9. Laboratory Facilities -- Each public water system shall have its own equipment and facilities for routine laboratory testing to ensure proper operation. Laboratory equipment selection shall be based on the characteristics of the raw water source and the complexity of the treatment process involved. Laboratory test kits that simplify procedures for making one or more tests may be acceptable. Necessary laboratory tests shall be performed by an operator or chemist qualified to perform the tests. Analyses conducted to determine compliance with drinking water regulations shall be performed in a laboratory certified by the United States

Environmental Protection Agency or the West Virginia Office of Laboratory Services and shall be performed in accordance with "Standard Methods for the Examination of Water and Wastewater" or alternative methods approved by the Environmental Engineering Division. Persons designing and equipping laboratory facilities shall confer with the Environmental Engineering Division before beginning the preparation of plans or the purchase of equipment.

3.9.a. Testing equipment -- As a minimum, the following laboratory equipment shall be provided:

3.9.a.1. Surface water supplies shall have a nephelometric turbidimeter meeting the requirements of "Standard Methods for the Examination of Water and Wastewater";

3.9.a.2. Each surface water treatment plant utilizing flocculation and sedimentation, including those which lime softens, shall have a pH meter, jar test equipment, and titration equipment for both hardness and alkalinity;

3.9.a.3. Each ion-exchange softening plant, and lime softening plant treating only groundwater shall have a pH meter and titration equipment for both hardness and alkalinity;

3.9.a.4. Each iron removal plant shall have test equipment capable of accurately measuring iron to a minimum of 0.1 milligrams per liter. Each manganese removal plant shall have test equipment capable of accurately measuring manganese to a minimum of 0.05 milligrams per liter;

3.9.a.5. Public water systems shall have test equipment for determining both free and total chlorine residual by methods in "Standard Methods for the Examination of Water and Wastewater";

3.9.a.6. Public water systems that fluoridate shall have test equipment for determining fluoride by methods in "Standard Methods for the Examination of Water and Wastewater"; and

3.9.a.7. Public water systems that feed polyphosphates shall have test equipment capable of accurately measuring phosphates from 0.1 to twenty (20) milligrams per liter.

3.9.b. Physical facilities -- Sufficient bench space, adequate ventilation, adequate lighting, storage room, laboratory sink, and auxiliary facilities shall be provided. Air conditioning may be necessary.

3.10. Monitoring Equipment -- Water treatment plants designed to serve three thousand three hundred (3300) people or more shall be provided with continuous monitoring equipment (including recorders) to monitor water being discharged to the distribution system as follows:

3.10.a. Plants treating surface water and plants using lime for softening shall have the capability to monitor and record free chlorine residual and should consider having the capacity to monitor and record turbidity; and

3.10.b. Plants treating ground water using iron removal or ion exchange softening should have the capability to monitor and record free chlorine residual.

3.11. Sample Taps -- Sample taps shall be provided so that water samples can be obtained from each raw water source and from appropriate locations in each unit operation of the treatment system. Taps shall be consistent with sampling needs and shall not be of the petcock type. Taps used for obtaining samples for bacteriological analysis shall be of the smooth-nosed type without interior or exterior aerator, or other such appurtenance.

3.12. Facility Water Supply -- The facility water supply service line and the plant finished water sample tap shall be supplied from a source of finished water at a point where all chemicals have been thoroughly mixed, and the required disinfectant contact time has been achieved. There shall be no cross-connections between the facility water supply service line and any piping, troughs, tanks, or other treatment units containing wastewater, treatment chemicals, raw or partially treated water.

3.13. Wall Castings -- Consideration shall be given to providing extra wall castings built into the structure to facilitate future uses whenever pipes pass through walls of concrete structures.

3.14. Meters -- All water plants shall have a means of metering the raw, finished, backwash and plant use water.

3.15. Piping Color Code. -- To facilitate identification of piping in plants and pumping stations it is recommended that the color scheme in Table 64-77 A be utilized. In situations where two colors do not have sufficient contrast to easily differentiate between them, a six-inch band of contrasting color should be on one of the pipes at approximately thirty (30) inch intervals. The name of the liquid or gas should also be on the pipe. In some cases it may be advantageous to provide arrows indicating the direction of flow.

3.16. Disinfection -- All wells, pipes, tanks, and equipment that can convey or store potable water shall be disinfected in accordance with current AWWA procedures. Plans or specifications shall outline the procedure and include the disinfectant dosage, contact time, and method of testing the results of the procedure.

3.17. Manuals and Parts Lists -- An operation and maintenance manual including a parts list and parts order form shall be supplied to the water works as part of any proprietary unit installed in the facility.

3.18. Operator Instruction -- Provisions shall be made for operator instruction at the start-up of a plant or pumping station following manufacturers' representatives trouble shooting.

3.19. Paints, Coatings, Sealers and Liners -- Paints, coatings, sealers and liners that contact raw, partially treated or potable water and are used in pipes, tanks or equipment that can transport or store water shall have third party certification of compliance with ANSI\NSF Standard 61: Drinking Water System Components - Health Effects.

3.20. Other Considerations -- Consideration shall be given to the design requirements of other federal, state and local regulatory agencies for items such as safety requirements, special designs for the disabled, plumbing and electrical codes, construction in the flood plain, etc.

§64-77-4. Source Development.

4.1. General -- In selecting the source of water to be developed, the designing engineer shall prove to the satisfaction of the Environmental Engineering Division that an adequate quantity of water will be available, and that the water that is to be delivered to the consumers will meet the current requirements of the rule of the Division of Health, Public Water Systems, 64CSR3, with respect to microbiological, physical, chemical and radiological qualities. Each water system should take its raw water from the best available source that is economically reasonable and technically possible.

4.2. Surface Water -- A surface water source includes all tributary streams and drainage basins, natural lakes, artificial reservoirs or impoundments above the point of water system intake and ground water under the direct influence of surface water.

4.2.a. Quantity -- The quantity of water at the source: shall be adequate to meet the maximum projected water demand of the service area as shown by calculations based on the extreme drought of record; shall provide a reasonable surplus for anticipated growth; shall be adequate to compensate for all losses such as silting, evaporation, seepage, etc.; shall be adequate to provide ample water for other legal users of the source; shall not exceed a rate of withdrawal that is more than ten (10) percent of the minimum available flow in a stream; and shall provide minimum six (6) months storage based on average daily demand for all drainage basins, natural lakes and artificial reservoirs or impoundments.

4.2.b. Quality -- A sanitary survey and study shall be made of the factors, both natural and man made, that may affect quality. Such survey and study shall include, but not be limited to: determining possible future uses of impoundments or reservoirs; determining the degree of control of water shed by the owner; assessing degree of hazard to the supply by accidental spillage of materials that may be toxic, harmful or detrimental to treatment processes; obtaining samples over a sufficient period of time to assess the microbiological, physical, chemical and radiological characteristics of the water; assessing the capability of the proposed treatment process to reduce contaminants to applicable standards; and consideration of currents, wind and ice conditions, and the effect of confluent streams. The coliform group shall not exceed five thousand (5000) per one hundred (100) milliliters as a monthly average value (MPN or MF count), nor exceed this number in more than twenty per cent (20%) of the samples examined during any month, nor exceed twenty thousand (20,000) per one hundred (100) milliliters in more than five per cent (5%) of the samples.

4.2.c. Minimum Treatment -- The design of the water treatment plant shall consider the worst conditions that may exist during the life of the facility. The minimum treatment required shall be determined by the Environmental Engineering Division. Filtration preceded by pretreatment approved by the Environmental Engineering Division shall be provided for all surface waters.

4.2.d. Structures.

4.2.d.1. Design of intake structures shall provide for: withdrawal of water

from more than one level if quality varies with depth; separate facilities for release of less desirable water held in storage; where frazil ice may be a problem, holding the velocity of flow into the intake structure to a minimum, generally not to exceed 0.5 feet per second; inspection manholes every one thousand (1000) feet for pipe sizes large enough to permit visual inspection; periodic cleaning of the inlet line; and adequate protection against rupture by dragging anchors, ice, etc. Ports shall be located above the bottom of the stream, lake or impoundment, but at sufficient depth to be kept submerged at low water levels. Where shore wells are not provided, a diversion device shall be capable of keeping large quantities of fish or debris from entering an intake structure and of controlling zebra mussels where applicable.

4.2.d.2. Shore wells shall: have motors and electrical controls located above grade and above the one hundred (100) year flood elevation; be accessible; be designed against flotation; be equipped with removable or traveling screens before the pump suction well; provide for introduction of a disinfectant or other chemicals in the raw water transmission main if necessary for quality control; have intake valves and provisions for backflushing or cleaning by a mechanical device and testing for leaks, where practical; and have provisions for withstanding surges where necessary and include provisions for adequate ventilation for maintenance personnel.

4.2.d.3. An upground reservoir is a facility in which water is pumped during periods of good quality and high stream flow for future release to treatment facilities. Upground reservoirs shall be constructed to assure that: water quality is protected by controlling runoff into the reservoir; dikes are structurally sound and protected against wave action and erosion; intake structures and devices meet requirements of this section; point of influent flow is separated from the point of withdrawal; and separate pipes are provided for influent to and effluent from the reservoir.

4.2.e. Impoundments and reservoirs.

4.2.e.1. Site preparation shall provide, where applicable: for the removal of brush and trees to high water elevation; for protection from floods during construction; for the abandonment of all water wells that will be inundated, in accordance with requirements of the Environmental Engineering Division; and for the abandonment of all oil and gas wells in accordance with WVDEP oil and gas regulations.

4.2.e.2. Construction may require: approval from the WVDEP of the safety features for stability and spillway design; a permit from the WVDEP for controlling stream flow or installing a structure on the bed of a stream or interstate waterway; a withdrawal permit; and an U.S. Army Corps of Engineers permit.

4.3. Groundwater -- A groundwater source includes all water obtained from drilled, bored or driven wells, infiltration lines, springs and state or federally approved sealed mines.

4.3.a. Quantity.

4.3.a.1. Source Capacity -- The total developed groundwater source

capacity shall equal or exceed the design maximum day demand. For systems serving five hundred (500) people or more, source capacity shall equal or exceed the design average day demand with the largest producing well out of service.

4.3.a.2. Number of Sources -- A minimum of two (2) good sources of water shall be provided for all community groundwater systems serving five hundred (500) or more people, with sufficient capacity so that with the largest producing source out of service the remaining source or sources can produce sufficient quantity to produce average daily demands.

4.3.a.3. Standby Power for systems greater or equal to three (3) million gallons per day.

4.3.a.3.A. To ensure continuous service when the primary power has been interrupted, a power supply should be provided through connection to at least two (2) independent public power sources, or portable or in-place auxiliary power.

4.3.a.3.B. When automatic pre-lubrication of pump bearings is necessary, and an auxiliary power supply is provided, the pre-lubrication line shall be provided with a valved bypass around the automatic control, or the automatic control shall be wired to the emergency power source.

4.3.b. Quality

4.3.b.1. Microbiological Quality -- Disinfection of every new, modified or reconditioned groundwater source shall be provided prior to use in accordance with AWWA Standard C654. After disinfection, in accordance with AWWA Standard C654, one (1) or more special purpose water samples shall be submitted to a State certified water quality laboratory for microbiological analysis with results reported to the Environmental Engineering Division prior to placing the well into service.

4.3.b.2. Physical and Chemical Quality -- Every new groundwater source shall be examined for all regulated primary and secondary contaminants by tests of a representative sample in a State certified water quality laboratory for drinking water, with the results reported to the Environmental Engineering Division. Samples shall be collected at the conclusion of the test pumping procedure and examined as soon as practical. Field determinations of physical and chemical constituents or special sampling procedures may be required by the Environmental Engineering Division.

4.3.c. Location.

4.3.c.1. The Environmental Engineering Division shall be consulted prior to design and construction regarding a proposed well location as it relates to required separation between existing and potential sources of contamination and groundwater development. Include with the request for consultation a location map, site map and an inventory of potential contamination activity sources within a two thousand (2000) foot radius

of the proposed well location. The water well shall be located a minimum distance of two thousand (2000) feet from any existing or potential sources of chemical or radiological pollution or contamination unless approved by the Environmental Engineering Division. Under no circumstances shall the water well be located closer to sources of microbiological pollution or contamination than as provided in Table 64-77 B.

4.3.c.2. Continued Protection -- Continued protection of the well site from potential sources of contamination shall be provided through the development of a wellhead protection program as approved by the Environmental Engineering Division. Fencing of the site may be required by the Environmental Engineering Division.

4.3.d. Testing and Records.

4.3.d.1. Yield and drawdown tests shall: be performed on every production well after construction or subsequent treatment and prior to placement of the permanent pump; have the test methods clearly indicated in the project specifications; have a test pump capacity, at maximum anticipated drawdown, at least 1.5 times the quantity anticipated, and provide for continuous pumping for at least twenty-four (24) hours or until stabilized drawdown has continued for at least six (6) hours when test pumped at 1.5 times the design pumping rate for community and non-transient non-community public water supplies; and provide for continuous pumping for at least six (6) hours when test pumped at 1.5 times the design pumping rate for transient non-community public water supplies.

4.3.d.2. The designing engineer shall provide the following data to the Environmental Engineering Division: test pump capacity-head characteristics; static water level; depth of test pump setting; time of starting and ending each test cycle; and the zone of influence for the well or wells.

4.3.d.3. The designing engineer shall provide recordings and graphic evaluation of the following at one hour intervals or less as may be required by the Environmental Engineering Division: pumping rate; pumping water level; drawdown; and water recovery rate and levels.

4.3.d.4. Every well serving five hundred (500) people or more shall be tested for plumbness and alignment in accordance with AWWA standards. The test method and allowable tolerance shall be clearly stated in the specifications. If the well fails to meet these requirements, it may be accepted by the engineer if it does not interfere with the installation or operation of the pump or uniform placement of grout.

4.3.d.5. Geological data shall: be determined from samples collected at five (5) foot intervals and at each pronounced change in formation; be recorded and reported submitted to the Environmental Engineering Division; be supplemented with information on accurate records of drill hole diameters and depths, assembled order of size and length of casing and liners, grouting depths, formations penetrated, water levels, and location of any blast charges.

4.3.e. General Well Construction.

4.3.e.1. Wells shall be covered while unattended during construction. Drilling fluids and additives: shall not impart any toxic substances to the water or promote bacterial contamination; and shall have third party certification of conformance with ANSI/NSF Standard 60, Drinking Water Treatment Chemicals - Health Effects.

4.3.e.2. Minimum Protected Depths -- Minimum protected depths of drilled wells shall provide watertight construction to such depth as may be required by the Environmental Engineering Division to: exclude contamination; seal off formations that are, or may be, contaminated or yield undesirable water; and provide a minimum of thirty (30) feet of casing in unconsolidated water bearing formations or ten (10) feet of unweathered bedrock. Unweathered bedrock is bedrock that is competent, hard, firmly-consolidated and unaltered by erosion or surficial weathering. In special circumstances (i.e., the well supplies a surface water treatment plant) other minimum protective depths of casing may be allowed, upon the written approval of the Environmental Engineering Division.

4.3.e.3. Temporary Steel Casing -- Temporary steel casing used for construction shall be capable of withstanding the structural load imposed during its installation and removal.

4.3.e.4. Permanent Steel Casing -- Permanent steel casing pipe shall: be new steel casing pipe meeting AWWA Standard A-100, ASTM or API specifications for water well construction; have minimum weights and thickness indicated in Table 64-77 D; have additional thickness and weight if minimum thickness is not considered sufficient to assure reasonable life expectancy of a well; be capable of withstanding forces to which it is subjected; be equipped with a commercial drive shoe when driven; have full circumferential welds or threaded coupling joints; and have certification of compliance in accordance with ANSI/NSF Standard 61, Water System Components - Health Effects.

4.3.e.5. Nonferrous Casing Materials -- Nonferrous material proposed as a well casing: shall be resistant to the corrosiveness of the water and to the stresses to which it will be subjected during installation, grouting and operation; and shall comply with ANSI/NSF Standard 61, Water System Components - Health Effects.

4.3.e.6. Plastic Well Casing -- Plastic well casings, couplings and solvents shall be approved by the NSF and shall meet ASTM F-480. All plastic well casings and couplings shall bear the NSF-wc (well casing) marks for use in wells. All solvent materials shall bear the NSF marks. Plastic well casing shall not be driven during the well installation and shall be installed in accordance with the manufacturer's specifications. The use of plastic pipe for well liners and temporary casings is permitted provided the casing or liner meets the NSF-pw (potable water) requirements for plastic piping and the well is not used for electrical grounding.

4.3.e.7. Packers -- Packers shall be of material that will not impart taste, odor, toxic substance or bacterial contamination to the well water. Lead packers shall not be

used.

4.3.e.8. Screens -- Screens shall: be constructed of materials resistant to damage by chemical action of groundwater or cleaning operations and have size of openings based on sieve analysis of formation or gravel pack materials; and have sufficient length and diameter to provide adequate specific capacity and low aperture entrance velocity. Usually the entrance velocity should not exceed 0.1 feet per second. Screens shall be installed so that the pumping water level remains above the screen under all operating conditions. Where applicable, screens shall be designed and installed to permit removal or replacement without adversely affecting watertight construction of the well and be provided with a bottom plate or washdown bottom fitting of the same material as the screen. Only commercially manufactured screens designed for the intended purpose are permitted. Plastic well screens shall comply with the ANSI/NSF Standard 61 - Water System Components - Health Effects.

4.3.e.9. Grouting requirements.

4.3.e.9.A. The full length of the well casing shall be fully grouted from the lower terminus up to the ground surface, except as noted in parts 4.3.e.9.A.1 through 4.3.e.9.A.3 below.

4.3.e.9.A.1. When drilling through caves, mines or other cavities, the lower portion of the casing shall be grouted in accordance with a method described in this section and a packer or similar bridging device can be used to permit grouting from the top of the cavity, as shown in Figure 64-77 G of this rule.

4.3.e.9.A.2. In unconsolidated aquifers (i.e., sand and gravel) above bedrock, at a minimum the top twenty (20) feet of the permanent casing shall be grouted, from the top of a well screen gravel pack, at a point not more than ten (10) feet above the top of the well screen, up to the ground surface, as shown in Figure 64-77 H of this rule.

4.3.e.9.A.3. In cases where a pitless adaptor is to be installed, upward grouting may terminate at the level of the pitless adapter, as shown in Figure 64-77 I of this rule.

4.3.e.9.B. Grout shall be neat cement or neat cement with a maximum five percent (5%) bentonite as determined by the manufacturer. Other grout materials require the written approval of the Environmental Engineering Division. Neat cement grout shall consist of cement and water with not more than six (6) gallons of water per sack (ninety-four (94) pounds) of cement. Additives of bentonite clay up to five percent (5%) by weight (three (3) to five (5) pounds of clay mixed with six (6) gallons of water per sack of cement) may be used to increase fluidity and reduce shrinkage.

4.3.e.9.C. Grout shall be installed by the following method:

4.3.e.9.C.1. Positive Placement - Exterior Method -- Grout

material shall be placed by a positive displacement method such as pumping or forced injection by air or hydraulic pressure. Grout shall be injected in the annular space between the inner casing and either the outer casing or the borehole. The annular space shall be a minimum of 1½ inches for grout. The grout pipe shall extend from the surface to the bottom of the zone to be grouted. The grout pipe shall have a minimum inside diameter of one (1) inch for grout. Grout shall be placed, from bottom to top, in one continuous operation. The grout pipe shall be raised as the grout is placed but the discharge end of the grout pipe shall be submerged in the emplaced grout at all times until grouting is completed. The grout pipe shall be maintained full, to the surface, at all times until the completion of the grouting of the entire specified zone. In the event of interruption in the grouting operations, the bottom of the pipe should be raised above the grout level and should not be re-submerged until all air and water have been displaced from the grout pipe and the pipe is flushed clean with clear water. This grouting method is acceptable using either plastic or steel casings and is compatible with all drilling methods.

4.3.e.9.C.2. All other methods require the written approval of the Environmental Engineering Division.

4.3.e.9.D. If rapid loss of grout material occurs during emplacement, coarse fill material (e.g., sand, gravel, crushed stone or dry cement) may be used in the zones in which the loss is occurring. The remainder of the annular space shall be grouted as provided in this section. If the annular space cannot be grouted in accordance with this section, alternative methods subject to prior written approval by the Environmental Engineering Division will be considered.

4.3.e.10. Upper Terminal Well Construction - Permanent casing for all groundwater sources shall project at least twelve (12) inches above the pumphouse floor or at least twelve (12) inches above the final ground surface. Where a well house is constructed, the floor surface shall be at least six (6) inches above the final ground elevation. Sites subject to flooding shall be provided with an earth mound to raise the pumphouse floor to an elevation at least two (2) feet above the highest known flood elevation, or other suitable protection as determined by the Environmental Engineering Division. The top of the well casing at sites subject to flooding shall terminate at least three (3) feet above the one hundred (100) year flood level or the highest known flood elevation, whichever is higher, or as the Environmental Engineering Division directs. If the three (3) feet above the one hundred (100) year flood elevation requirement cannot be met, the well must be protected from flood waters entering the well and contaminating the aquifer.

4.3.e.11. Development -- Every well shall be developed to remove the native silts and clays, drilling mud or finer fraction of the gravel pack. Development should continue until the maximum specific capacity is obtained from the completed well. Where chemical conditioning is required, the specifications shall include provisions for the method, equipment, chemicals, testing for residual chemicals, and disposal of waste and inhibitors. Where blasting procedures may be used, the specifications shall include the provisions for blasting and cleaning. Special attention shall be given to assure that the grouting and casing are not damaged by the blasting.

4.3.e.12 Capping Requirements -- All caps shall be Water Systems Council approved. At all times during the progress of work, the contractor shall provide protection to prevent tampering with the well or entrance of foreign materials.

4.3.e.13 Well Abandonment -- The preferred method of abandonment involves casing removal. The borehole shall be completely sealed to reduce concern about channeling in the annular space or inadequate seals between casing and grout. When the casing is removed and the borehole is unstable, grout shall be simultaneously emplaced as the casing is "pulled" to prevent collapse of the borehole and an inadequate seal; however, if the casing is left in place, the casing shall be completely pressure grouted to reduce the possibility of annular channeling. All pumps, wiring, pipes, valves, accessories and hardware shall be removed prior to abandonment. The requirements herein pertain to wells and test holes in consolidated and unconsolidated formations. Each well abandonment should be considered as an individual problem. Methods and materials are to be selected only after careful consideration of casing material, casing condition, diameter of the casing, quality and quantity of the original grout seal, depth of the well, well plumbness, hydrogeologic setting, level of contamination and the zones where contamination occurs.

4.3.e.13.A. All wells, except those in unconsolidated formations, shall be filled from sixty-five (65) feet below surface elevation to the surface or from ten (10) feet below casing to the surface, whichever is greater. Wells less than sixty-five (65) feet shall be completely filled. All test wells and water wells not in use shall be filled or sealed by such measures necessary to prohibit groundwater contamination. Procedures and quantities of material used for water well abandonment shall be provided to the Environmental Engineering Division within thirty (30) days after abandonment.

4.3.e.13.B Wells in Unconsolidated Formations -- In water-bearing formations consisting of coarse gravel, and producing wells are located nearby, care shall be taken to select sealing materials that will not affect the producing wells. Concrete may be used if the producing wells can be shut down for a sufficient time to allow the concrete to set. Clean, disinfected sand or gravel may also be used as fill material at the water-bearing formation elevations. The remainder of the well, especially the upper portion, should be filled with clay, concrete, grout, or neat cement to exclude surface water. The latter method, using clay as the upper sealing material, is especially applicable to larger than ten (10) inch diameter abandoned wells. In gravel-packed gravel-envelope, or other wells in which coarse material has been added around the inner casing to within twenty (20) to thirty (30) feet of the surface, sealing outside the casing is very important. Sometimes this sealing may require removal of the gravel or perforation of the casing.

4.3.e.13.C. Wells in Creviced Formations -- Abandoned wells that penetrate limestone or other creviced or channelized rock formations shall be filled with concrete, grout or neat cement to insure permanence of the seal. The use of clay or sand is not desirable because fine-grained fill material may be displaced by the flow of water through crevices of channels. Alternating layers of coarse stone and concrete may be used for fill material through the water producing horizon if limited vertical movement of water in the formation will not effect the quality or quantity in producing wells. Only concrete, neat cement

or grout should be used in this type of well. The portion of the well between a point ten (10) to twenty (20) feet below and a point ten (10) to twenty (20) feet above the creviced formation shall be sealed and a plug of sealing material formed above the creviced formation.

4.3.f. SourceTypes and Construction Methods - Special Conditions.

4.3.f.1. Radial Water Collector -- Locations of all caisson construction joints and porthole assemblies shall be indicated. The caisson wall shall be reinforced to withstand the forces to which it will be subjected. Radial collectors shall be in areas and at depths approved by the Environmental Engineering Division. Provisions shall be made to assure that radial collectors are horizontal. The top of the caisson shall be covered with a watertight floor. All openings in the floor shall be curbed and protected from entrance of foreign material. The pump discharge piping shall be placed through the caisson walls using commercially available watertight wall sleeves.

4.3.f.2. Infiltration Lines -- Infiltration lines may be considered only where geological conditions preclude the possibility of developing an acceptable drilled well. The area around infiltration lines shall be under the control of the water purveyor for a distance acceptable to or required by the Environmental Engineering Division. Flow in the lines shall be by gravity to the collecting well.

4.3.f.3. Naturally Flowing Wells -- Flow from naturally flowing wells shall be controlled. Permanent casing and grout shall be provided. If erosion of the confining bed appears likely, special protective construction may be required by the Environmental Engineering Division.

4.3.f.4. Springs and Mine Openings -- Springs and mine openings shall be protected from entry of surface water and foreign objects and shall be housed in a permanent structure.

4.3.g. Well Pumps, Discharge Piping and Appurtenances.

4.3.g.1. Line shaft pumps - Wells equipped with line shaft pumps shall: have the pump structure firmly connected to the casing or have the casing inserted into a recess extending at least one-half (½) inch into the pump base; have the pump foundation and base designed to prevent water from coming into contact with the joint; and avoid the use of oil lubrication at pump settings less than four hundred (400) feet.

4.3.g.2. Submersible pumps -- Where a submersible pump is used, the top of the casing shall be effectively sealed against the entrance of water under all conditions of vibration or movement of conductors or cables, and the electrical cable shall be firmly attached to the riser pipe at twenty (20) foot intervals or less,

4.3.g.3. Discharge piping -- The discharge piping shall: be designed so that the friction loss will be low; have control valves and appurtenances located above the pumphouse floor when an above-ground discharge is provided; be protected against the

entrance of contamination; be equipped with a check valve, a shutoff valve, a pressure gauge, a means of measuring flow, and a smooth nosed sampling tap located at a point where positive pressure is maintained. Where applicable, discharge piping shall be equipped with an air release-vacuum relief valve located upstream from the check valve, with exhaust/relief piping terminating in a down-turned position at least eighteen (18) inches above the floor and covered with a twenty-four (24) mesh corrosion resistant screen. Discharge piping: shall be valved to permit test pumping and control of each well; shall have all exposed piping, valves and appurtenances protected against physical damage and freezing; shall be properly anchored to prevent movement; and shall be protected against a surge or water hammer. The discharge piping should be provided with a means of pumping to waste but shall not be directly connected to a sewer.

4.3.g.4. Pitless Well Units -- The Environmental Engineering Division shall be contacted for approval of specific applications of pitless units. Pitless units shall: be threaded or welded to the well casing; be of watertight construction throughout; be of materials and weight at least equivalent and compatible to the casing; have field connection to the lateral discharge from the pitless unit of threaded, flanged or mechanical joint connection; terminate at least twelve (12) inches above final ground elevation or three (3) feet above the one hundred (100) year flood level or as the Environmental Engineering Division directs. If the three (3) feet above the one hundred (100) year flood elevation requirement cannot be met, the well must be protected from flood waters entering the well and contaminating the aquifer. The pitless unit installation shall consist of either a pitless well unit or pitless well adapter and well cap. The pitless unit shall be approved by the NWSC, NGWA or equivalent. If a field weld connection is made, the pitless well unit shall be specifically approved by the manufacturer for such welding. The only field welding permitted is that required to attach the pitless well unit to the casing. Water tightness of the weld shall be tested by pressurized air to one hundred (100) pounds per square inch with pressure loss less than two (2) pounds per square inch within one (1) hour.

4.3.g.4.A. The design of the pitless unit shall make provisions for: access to disinfect the well; a properly constructed casing vent meeting the requirements specified herein; facilities to measure water levels in the well; a cover at the upper terminus of the well that will prevent contamination; a contamination-proof entrance connection for electrical cable; and an inside diameter as great as that of the well casing, up to and including casing diameters of twelve (12) inches, to facilitate work and repair on the well, pump, or well screen. If the three (3) feet above the one hundred (100) year flood elevation requirement cannot be met, the well must be protected from flood waters entering the well and contaminating the aquifer.

4.3.g.5. Casing Vent -- Provisions shall be made for venting the well casing to the atmosphere. The vent shall terminate in a down turned position, at or above the top of the casing or pitless unit in a minimum one (1) inch diameter opening covered with a twenty-four (24) mesh, corrosion resistant screen. The pipe connecting the casing to the vent shall be of adequate size to provide rapid venting of the casing.

4.3.g.6. Water level measurement - Provisions shall be made for

periodic measurement of water levels in the completed well. Where pneumatic water level measuring equipment is used, the measurement shall be made using corrosion resistant materials attached firmly to the drop pipe or pump column and in such a manner as to prevent entrance of foreign materials.

4.3.g.7. Observation wells shall: be constructed in accordance with the requirements for permanent wells if they are to remain in service after completion of a water supply well; and be protected at the upper terminus to preclude entrance of foreign materials.

§64-77-5. Treatment (General and Clarification).

5.1. General. -- The design of treatment processes and devices shall depend on evaluation of the nature and quality of the particular water to be treated, the desired quality of the finished water and the mode of operation planned. All treatment processes with only one (1) unit shall be capable of meeting the projected maximum daily demand in eight (8) hours of operation or less to provide "down time" for repairs and maintenance.

5.2. Clarification. -- Plants designed for processing surface water shall: provide a minimum of two (2) units each for rapid mix, flocculation and sedimentation unless otherwise approved by the Environmental Engineering Division; permit operation of the units either in series or parallel where softening is performed and should permit series or parallel operation where plain clarification is performed; be constructed to permit units to be taken out of service without disrupting operation; be constructed with drains or pumps sized to allow dewatering in a reasonable period of time; provide multiple-stage treatment facilities when required by the Environmental Engineering Division; be started manually following a shutdown; and minimize hydraulic head losses between units to allow future changes in processes without the need for repumping. For ground water systems under the direct influence of surface water, the above requirements may be modified by the Environmental Engineering Division, depending on the raw water quality characteristics.

5.2.a. Rapid mix means the rapid dispersion of chemicals throughout the water to be treated, usually by violent agitation. The engineer shall submit the design basis for the velocity gradient (G value) selected, considering the chemicals to be added, water temperature, color and other related water quality parameters.

5.2.a.1. Equipment -- Basins shall be equipped with mechanical mixing devices. Other arrangements, such as baffling, may be acceptable only under special conditions. Where mechanical mixing devices are utilized, duplicate units or spare mixing equipment shall be provided.

5.2.a.2. Design parameters -- The detention period shall be in the range of ten (10) to thirty (30) seconds. The point of application of the coagulant shall be at the point of maximum mixing intensity. The physical configuration of the mixing basin shall be designed to eliminate vortexing. Rapid mix units should be designed to allow a speed variation ratio throughout at a range of one (1) to three (3). The rapid mix and flocculation basin shall be as close together as possible. Static mixers shall be properly selected and approved by the Environmental Engineering Division.

5.2.b. Flocculation -- Flocculation means the agitation of the water at low velocities for long periods of time.

5.2.b.1. Basin design -- Inlet and outlet design shall prevent short-circuiting and destruction of floc. A drain or pumps, or both, shall be provided to handle dewatering and sludge removal.

5.2.b.2. Detention -- The flow-though 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 thirty (30) minutes.

5.2.b.3. Equipment -- Agitators shall be driven by variable speed drives with the peripheral speed of paddles ranging from 0.5 to three (3.0) feet per second.

5.2.b.4. 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, elevation drops and changes in direction.

5.2.b.5. Superstructure -- A superstructure over the flocculation basins may be required.

5.2.c. Sedimentation -- Sedimentation shall follow flocculation. The detention time for effective clarification is dependent upon a number of factors related to basin design and the nature of the raw water. The following criteria apply to conventional sedimentation units:

5.2.c.1. Detention time -- A minimum of four (4) hours of settling time shall be provided. This may be reduced to two (2) hours for lime-soda softening facilities treating only groundwater. Reduced sedimentation time may also be approved by the Environmental Engineering Division when equivalent effective settling is demonstrated (i.e., tube settlers, lamella plates, etc.) but shall never be less than two (2) hours.

5.2.c.2. Inlet devices -- Inlets shall be designed to distribute the water equally and at uniform velocities. Open ports, submerged ports, and similar entrance arrangements are required. A baffle shall be constructed across the basin close to the inlet end and should project several feet below the water surface to dissipate inlet velocities and provide uniform flows across the basin;

5.2.c.3. Outlet devices -- Outlet devices shall be designed to maintain velocities suitable for settling in the basin and to minimize short-circuiting. The use of submerged orifices is recommended in order to provide a volume above the orifices for storage when there are fluctuations in flow;

5.2.c.4. Overflow rate -- The rate of flow over the outlet weir shall not exceed twenty thousand (20,000) gallons per day per foot of weir length. Where submerged orifices are used as an alternate for overflow weirs, they should be not lower than three feet below the flow line with flow rates equivalent to weir loadings;

5.2.c.5. Velocity -- The velocity through settling basins shall not exceed 0.5 feet per minute. The basins shall be designed to minimize short-circuiting. Fixed or adjustable baffles shall be provided as necessary to achieve the maximum potential for clarification;

5.2.c.6. Overflow -- An overflow weir (or pipe) should be installed that will establish the maximum water level desired on top of the filters. It shall discharge by gravity with a free fall at a location where the discharge will be noted;

5.2.c.7. Superstructure -- A superstructure over the sedimentation basins may be required. If there is no mechanical equipment in the basins and if provisions are included for adequate monitoring under all expected weather conditions, a cover may be provided in lieu of a superstructure;

5.2.c.8. Sludge collection -- Mechanical sludge collection equipment should be provided;

5.2.c.9. Drainage -- Basins shall be provided with a means for dewatering. Basin bottoms should slope toward the drain not less than one (1) foot in twelve (12) feet where mechanical sludge collection equipment is not required;

5.2.c.10. Flushing lines -- Flushing lines or hydrants shall be provided and shall be equipped with backflow prevention devices acceptable to the Environmental Engineering Division;

5.2.c.11. Safety -- Permanent ladders or handholds shall be provided on the inside walls of basins. Guard rails shall be included;

5.2.c.12. Sludge removal -- Sludge removal design shall provide that sludge pipes shall be not less than three (3) inches in diameter and so arranged as to facilitate cleaning. The entrance to sludge withdrawal piping shall prevent clogging. The operator may observe and sample sludge being withdrawn from the unit; and

5.2.c.13. Sludge disposal -- Facilities shall be provided for the disposal of sludge.

5.2.d. Solids contact unit -- Units are generally acceptable for combined softening and clarification where water characteristics, especially temperature, do not fluctuate rapidly, flow rates are uniform and operation is continuous. Before such units are considered as clarifiers without softening, specific approval of the Environmental Engineering Division shall be obtained. Clarifiers should be designed for the maximum uniform rate and should be adjustable to changes in flow that are less than the design rate and for changes in water characteristics. A minimum of two (2) units are required for surface water treatment unless otherwise approved by the Environmental Engineering Division.

5.2.d.1. Installation of equipment -- Supervision by representative of the manufacturer shall be provided with regard to all mechanical equipment at the time of installation, during trouble shooting, problem solving and start-up and initial operation.

5.2.d.2. Operating equipment -- The following shall be provided for plant

operation: complete outfit of tools and accessories; trouble shooting and problem solving manuals; necessary laboratory equipment; and adequate piping with suitable sampling taps so located as to permit the collection of samples of water from critical portions of the units.

5.2.d.3. Chemical feed -- Chemicals shall be applied at such points and by such means as to insure satisfactory mixing of the chemicals with the water.

5.2.d.4. Mixing -- A rapid mix device or chamber ahead of solids contact units may be required by the Environmental Engineering Division to assure proper mixing of the chemicals applied. Mixing devices employed shall be so constructed as to provide mixing of the raw water with previously formed sludge particles, and prevent deposition of solids in the mixing zone.

5.2.d.5. Flocculation -- Flocculation equipment shall: be adjustable (speed or pitch, or both); provide for coagulation in a separate chamber or baffled zone within the unit; and provide the flocculation and mixing period to be not less than thirty (30) minutes.

5.2.d.6. Sludge concentrators -- The equipment should provide either internal or external concentrators in order to obtain a concentrated sludge with a minimum of waste water. Large basins should have at least two (2) sumps for collecting sludge with one (1) sump located in the central flocculation zone.

5.2.d.7. Sludge removal -- Sludge removal design shall provide that sludge pipes shall be not less than three (3) inches in diameter and so arranged as to facilitate cleaning. Entrance to sludge withdrawal piping shall prevent clogging. The design shall permit the operator to observe and sample sludge being withdrawn from the unit.

5.2.d.8. Cross-connections -- Blow-off outlets and drains shall terminate and discharge at places satisfactory to the Environmental Engineering Division. Cross-connection control shall be included for the potable water lines used to backflush sludge lines.

5.2.d.9. Detention period -- The detention time shall be based on the raw water characteristics and other local conditions that effect the operation of the unit. Based on design flow rates, the detention time should be two (2) to four (4) hours for suspended solids contact clarifiers and softeners treating surface water and one (1) to two (2) hours for the suspended solids contact softeners treating only groundwater.

5.2.d.10. Suspended slurry concentrate -- Softening units should be designed so that continuous slurry concentrates of one per cent (1%) or more, by weight, can be satisfactorily maintained.

5.2.d.11. Water losses -- Units shall be provided with suitable controls for sludge withdrawal. Total water losses should not exceed five percent (5%) for clarifiers and three percent (3%) for softening units. The solids concentration of sludge bed to waste should be three percent (3%) by weight for clarifiers and five percent (5%) by weight for softeners.

5.2.d.12. Weirs or orifices -- The units should be equipped with either overflow weirs or orifices constructed so that water at the surface of the unit does not travel more than ten (10) feet horizontally to the collection trough. Weirs shall be adjustable and at least equivalent in length to the perimeter of the tank. Weir loading shall not exceed ten (10) gallons per minute per foot of weir length for units used for clarifiers and twenty (20) gallons per minute per foot of weir length for units used for softeners. Where orifices are used, the loading rates per foot of launder rates should be equivalent to weir loadings. Either weirs or orifices shall produce uniform rising rates over the entire area of the tank.

5.2.d.13. Upflow rates -- Supporting data shall be submitted to the Environmental Engineering Division to justify rates exceeding the following: one (1) gallon per minute per square foot of area at the sludge separation line for units used for clarifiers; and 1.75 gallons per minute per square foot of area at the slurry separation line; for units used for softeners. If flow is subject to surges, an equalization tank should be provided.

5.2.e. Tube or plate settlers -- Commercial settler units consisting of variously shaped tubes or plates that are installed in multiple layers and at an angle to the flow may be used for sedimentation following flocculation.

5.2.e.1. General criteria.

5.2.e.1.A. Inlet and outlet considerations -- Design to maintain velocities suitable for settling in the basin and to minimize short-circuiting.

5.2.e.1.B. Drainage -- Drain piping from the settler units shall be sized to facilitate a quick flush of the settler units and to prevent flooding other portions of the plant.

5.2.e.1.C. Protection from freezing -- Although most units will be located within a plant, outdoor installations shall provide sufficient freeboard above the top of settlers to prevent freezing in the units. A cover or enclosure is strongly recommended.

5.2.e.1.D. Application rate for tube settlers -- A maximum rate of two (2) gallons per square foot per minute of cross-sectional area (based on twenty-four (24) inch long sixty (60) degree tubes or 39.5-inch long 7 ½ degree tubes), unless higher rates are successfully shown through pilot plant or in-plant demonstration studies.

5.2.e.1.E. Application rate for Lamellae plates -- A maximum forward design flow through the inclined plate settler is 0.5 gallons per minute per square foot of effective projected inclined plate surface area. Projected area is the total plate area multiplied by the cosine of the inclination angle. Effective settling surface area shall be a maximum of eighty percent (80%) of the total projected plate surface area installed.

5.2.e.1.F. Flushing lines -- Flushing lines shall be provided to facilitate maintenance and shall be properly protected against backflow or back siphonage.

5.2.f. Other settling/flocculation processes -- Roughing filters, unconventional type flocculation and sedimentation may be approved by the Environmental Engineering Division on a case by case basis.

5.3. Filtration -- The application of any type of filter shall be supported by water quality data representing a reasonable period of time to characterize the variations in water quality. Experimental treatment studies may be required to demonstrate the applicability of the method of filtration proposed.

5.3.a. Rapid rate gravity filters.

5.3.a.1. Pretreatment -- The use of rapid rate gravity filters requires pretreatment. Pretreatment includes but is not limited to coagulation, flocculation, and sedimentation.

5.3.a.2. Rate of filtration -- The rate of filtration shall be determined through consideration of such factors as raw water quality, degree of pretreatment provided, filter media, water quality control parameters, competency of operation personnel, and other factors as required by the Environmental Engineering Division. The maximum rate shall be two (2) gallons per minute per square foot of filter area for sand media, four (4) gallons per minute per square foot of filter area for dual media, and six (6) gallons per minute per square foot of filter for mixed media. In any case, the filter rate shall be proposed and justified by the designing engineer to the satisfaction of the Environmental Engineering Division prior to the preparation of final plans and specifications.

5.3.a.3. Number -- For groundwater plants producing 0.2 million gallons per day or more, two (2) filter units are required. For surface water plants, at least two (2) units are required. Where only two (2) units are provided, each shall be capable of meeting the plant design capacity (normally the projected maximum daily demand) at the approved filtration rate. Where more than two (2) filter units are provided, the filters shall be capable of meeting the plant design capacity at the approved filtration rate with one (1) filter removed from service. Where declining rate filtration is provided, the variable aspect of filtration rates and the number of filters shall be considered when determining the design capacity for the filters.

5.3.a.4. Structural details and hydraulics -- The filter structure shall be designed to provide for: vertical walls within the filter; no protrusion of the filter walls into the filter media; covering by superstructure; head room to permit normal inspection and operation; minimum depth of filter box of 8 ½ feet; minimum water depth over the surface of the filter media of three (3) feet; trapped effluent to prevent backflow of air to the bottom of the filters; prevention of floor drainage to the filter with a minimum four (4) inch curb around the filter; prevention of flooding by providing overflow; maximum velocity of treated water in pipe and conduits to filters of two (2) feet per second; cleanouts and straight alignment for influent pipes or conduits where solids loading is heavy, or following lime-soda softening; washwater drain capacity to carry maximum flow; walkways around filters, to be not less than twenty-four (24) inches wide; safety handrails or walls around filter areas adjacent to normal walkways; and the

prevention of cross connections and common walls between potable and non-potable water.

5.3.a.5. Washwater troughs -- Washwater troughs should be constructed to have: the bottom elevation above the maximum level of expanded media during washing and the top elevation above the filter surface, not to exceed thirty (30) inches with a two (2) inch freeboard at the maximum rate of wash; the top edge level and all at the same elevation; spacing so that each trough serves the same number of square feet of filter area; and maximum horizontal travel of suspended particles to reach the trough not to exceed three (3) feet.

5.3.a.6. Filter -- The filter shall be constructed to provide the following characteristics: a total depth of not less than twenty-four (24) inches and generally not more than thirty (30) inches; and a minimum of twelve (12) inches of media with an effective size range no greater than 0.45 mm to 0.55 mm, and a specific gravity greater than other filtering materials within the filter.

5.3.a.7. Types of filter media.

5.3.a.7.A. Anthracite -- Clean crushed anthracite, or a combination of anthracite and other media may be considered on the basis of experimental data specific to the project, and it shall have: an effective size of 0.45 mm to 0.55 mm with uniformity coefficient not greater than 1.65 when used alone; an effective size of 0.8 mm to 1.2 mm with a uniformity coefficient not greater than 1.85 when used as a cap; and an effective maximum size of 0.8 mm for anthracite used as a single media on potable groundwater for iron and manganese removal only (effective sizes greater than 0.8 mm may be approved by the Environmental Engineering Division based upon on-site pilot plant studies).

5.3.a.7.B. Sand -- Sand shall be clean silica sand and have an effective size of 0.45 mm to 0.55 mm and a uniformity coefficient of not greater than 1.65.

5.3.a.7.C. Granular activated carbon (GAC) -- Granular activated carbon media may be considered. The design shall include the following: the media shall meet the basic specifications for filter media as given in this section except that larger size media may be allowed by the Environmental Engineering Division where full scale tests have demonstrated that treatment goals can be met under all conditions; there shall be provisions for a free chlorine residual and adequate contact time in the water following the filters and prior to distribution; there shall be means for periodic treatment of filter material for control of bacterial and other growth; and provisions shall be made for frequent replacement or regeneration if GAC is used for filtration.

5.3.a.7.D. Other Media -- Other media will be considered based on experimental data and operating experience.

5.3.a.7.E. Torpedo sand -- A three (3) inch layer of torpedo sand should be used as a supporting media for filter sand, and should have an effective size of 0.8 mm to 2.0 mm and a uniformity coefficient not greater than 1.7.

5.3.a.7.F. Gravel -- Gravel, when used as the supporting media, shall consist of hard, durable, rounded silica particles and shall not include flat or elongated particles. The coarsest gravel shall be approximately 2 ½ inches in size when the gravel rests directly on the strainer system and shall extend above the top of the perforated laterals. Not less than four (4) layers of gravel shall be provided in accordance with the size and depth distribution when used with perforated laterals, as illustrated in Table 64-77 C. Reduction of gravel depths may be considered upon justification to the Environmental Engineering Division when proprietary filter bottoms are specified.

5.3.a.8. Filter bottoms and strainer systems -- Departures from these standards may be acceptable for high rate filters and proprietary bottoms. 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 minimize loss of head in the manifold and laterals and assure even distribution of washwater and even rate of filtration over the entire area of the filter. The ratio of the area of the final openings of the strainer systems to the area of the filter shall be about 0.003. The total cross-sectional area of the laterals shall be about twice the total area of the final openings. The cross-sectional area of the manifold shall be 1 ½ to two (2) times the total area of the laterals.

5.3.a.9. Surface wash or subsurface wash -- Surface or subsurface wash facilities are required except for filters used exclusively for iron or manganese removal, and may be accomplished by a system of fixed nozzles or a revolving-type apparatus. All devices shall be designed with the provision for water pressures of at least forty-five (45) pounds per square inch and properly installed vacuum breaker or other device approved by the Environmental Engineering Division to prevent back siphonage if connected to the treated water system. The rate of flow shall be two (2) gallons per minute per square foot of filter area with fixed nozzles or 0.5 gallons per minute per square foot with revolving arms. Air wash can be considered based on experimental data and operating experiences.

5.3.a.10. Air scouring -- Air scouring can be considered in place of surface wash. Air flow for air scouring the filter shall be three (3) to five (5) standard cubic feet per minute per square foot of filter area when the air is introduced in the underdrain; a lower air rate shall be used when the air scour distribution system is placed above the underdrains. A method for avoiding excessive loss of the filter media during backwashing shall be provided. Air scouring shall be followed by a fluidization wash sufficient to re-stratify the media. Air shall be free from contamination. Air scour distribution systems should be placed below the media and supporting bed interface; if placed at the interface the air scour nozzles shall be designed to prevent media from clogging the nozzles or entering the air distribution system. Piping for the air distribution system shall not be flexible hose that will collapse when not under air pressure and shall not be a relatively soft material that may erode at the orifice opening with the passage of air at high velocity. Air delivery piping shall not pass down through the filter media nor shall there be any arrangement in the filter design that would allow short circuiting between the applied unfiltered water and the filtered water. Consideration should be given to maintenance and replacement of air deliver piping. The backwash delivery system shall be capable of fifteen (15) gallons per minute per square foot of filter surface area; however, when air scour is provided the backwash rate shall be variable and should not exceed eight (8)

gallons per minute per square foot unless operating experience shows that a higher rate is necessary to remove scoured particles from filter surfaces, and the filter underdrains shall be designed to accommodate air scour piping when the piping is installed in the underdrain.

5.3.a.11. Appurtenances -- The following shall be provided for every filter: influent and effluent sampling taps; loss of head gauge; rate of flow controls; and a rate-of-flow meter. A rate controller that limits the rate of filtration to a maximum rate shall be used. A pump or a flow meter in each filter effluent line may be used as the limiting device for the rate of filtration only after consultation with the Environmental Engineering Division. Provisions shall be made for filtering to waste (rewash) with appropriate measures for backflow prevention. It is recommended the following be provided for every filter: a continuous or rotating cycle turbidity recording device for surface water treatment plants; wall sleeves providing access to the filter interior at several locations for sampling or pressure sensing; and a pressure hose and storage rack at the operating floor for washing filter walls.

5.3.a.12. Backwash -- Provisions shall be made for washing filters with a minimum rate of fifteen (15) gallons per minute per square foot, consistent with water temperatures and specific gravity of the filter media. A rate necessary to provide for a fifty percent (50%) expansion of the filter bed is required. A reduced rate of ten (10) gallons per minute per square foot may be acceptable for full depth anthracite or granular activated carbon filters. Filtered water shall be provided at the required rate by washwater tanks, a washwater pump, or from the high service main. Washwater pumps shall be in duplicate unless an alternate means of obtaining washwater is available. Not less than fifteen (15) minutes of wash of one (1) filter at the design rate of wash. A washwater regulator or orifice plate on the main washwater line shall be provided to obtain the desired rate of filter wash with the washwater valves on the individual filters open wide. A rate-of-flow indicator, preferably with a totalizer, on the main washwater line, shall be located so that it can be easily read by the operator during the washwater process. The design shall prevent rapid changes in backwash water flow.

5.3.a.13. Miscellaneous -- Roof drains shall not discharge into the filters or basins and conduits preceding the filters. Provisions shall be made for continuous operation of all other filtering units while one filtering unit is out of operation. Rate of flow adjustments are mandatory so as not to overload filters in operation. Automatic start-up of filtering units is prohibited.

5.3.b. Rapid rate pressure filters -- The normal use of rapid rate pressure filters is for iron and manganese removal and may be used for surface supplies classified as groundwater under direct influence where turbidity is less than or equal to ten (10) NTU. Pressure filters shall not be used in the filtration of other surface supplies or following lime-soda softening.

5.3.b.1. General -- Minimum criteria relative to rate of filtration, structural details, hydraulics, filter media, etc., provided for rapid rate gravity filters also apply to pressure filters where appropriate.

5.3.b.2. Rate of filtration -- The rate shall not exceed three gallons per minute per square foot of filter area except where in-plant testing, as approved by the Environmental Engineering Division, has demonstrated satisfactory results at higher rates.

5.3.b.3. Details of design -- The filters shall be designed to provide for: loss of head gauges on the inlet and outlet pipes of each filter; an easily readable meter or flow indicator on each battery of filters (a flow indicator is recommended for each filtering unit); filtration and backwashing of each filter individually with an arrangement of piping as simple as possible to accomplish these purposes; minimum side wall shell height of five (5) feet (a corresponding reduction in side wall height is acceptable where proprietary bottoms permit reduction of the gravel depth); the top of the washwater collectors to be at least eighteen (18) inches above the surface of the media; the underdrain system to efficiently collect the filtered water and to uniformly distribute the backwash water at a rate not less than fifteen (15) gallons per minute per square foot of filter area; backwash flow indicators and controls that are easily readable while operating the control valves; an air release valve on the highest point of each filter; an accessible manhole to facilitate inspection and repairs; and means to observe the wastewater during backwashing, and construction to prevent cross-connection.

5.3.c. Diatomaceous earth filtration -- The use of diatomaceous earth filters may be considered for application to surface waters with turbidity less than or equal to ten (10) NTU and bacterial contamination less than or equal to one hundred (100) total coliforms per one hundred (100) ml and may be used for iron removal for groundwater providing the removal is effective and the water is of satisfactory sanitary quality before treatment.

5.3.c.1. Conditions of use -- Diatomaceous earth filters are expressly excluded from considerations for the following conditions: bacteria removal when contamination is greater than one hundred (100) total coliforms per one hundred (100) ml; color removal; turbidity removal where either the quantity of turbidity is greater than ten (10) NTU or the turbidity exhibits poor filterability characteristics; filtration of waters with algae; and chemical removal.

5.3.c.2. Pilot plant study -- Installation of a diatomaceous earth filtration system shall be preceded by a pilot plant study on the water to be treated. Conditions of the study such as duration, filter rates, head loss accumulation, slurry feed rates, turbidity removal, bacteria removal, etc., shall be approved by the Environmental Engineering Division prior to the study. Satisfactory pilot plant results shall be obtained prior to preparation of final construction plans and specifications. The pilot plant study shall demonstrate the ability of the system to meet applicable drinking water standards at all times.

5.3.c.3. Types of filters -- Pressure or vacuum diatomaceous earth filtration units will be considered for approval; however, the vacuum type is preferred for its ability to accommodate a design that permits observation of the filter surfaces to determine proper cleaning, damage to a filter element, and adequate coating over the entire filter area.

5.3.c.4. Treated water storage -- Treated water storage capacity in excess of normal requirements shall be provided: to allow operation of the filters at a uniform

rate during all conditions of system demand at or below the approved filtration rate; and to guarantee continuity of service during adverse raw water conditions without by-passing the system.

5.3.c.5. Number of units -- See "Rapid Rate Gravity Filters."

5.3.c.6. Pre-coat -- Application - A uniform pre-coat shall be applied hydraulically to each septum by introducing a slurry to the tank influent line and employing a filter-to-waste or recirculation system. Quantity - Diatomaceous earth in the amount of 0.1 pounds per square foot of filter area or an amount sufficient to apply a 1/16 inch coating should be used with recirculation. When pre-coating is accomplished with a filter-to-waste system, 0.15 to 0.2 pounds per square foot of filter area is recommended.

5.3.c.7. Body feed -- A body feed system to apply additional amounts of diatomaceous earth slurry during the filter run is required to avoid short filter runs or excessive head losses. Quantity - Rate of body feed is dependent on raw water quality and characteristics and shall be determined in the pilot plant study. Continuous mixing of the body feed slurry is required.

5.3.c.8. Filtration.

5.3.c.8.A. Rate of filtration -- The recommended nominal rate is one (1.0) gallon per minute per square foot of filter area with a maximum of 1.5 gallons per minute per square foot. The filtration rate shall be controlled by a positive means.

5.3.c.8.B. Head loss -- The head loss shall not exceed thirty (30) pounds per square inch for pressure diatomaceous earth filters, or a vacuum of fifteen (15) inches of mercury for a vacuum system.

5.3.c.8.C. Recirculation -- A recirculation or holding pump shall be employed to maintain differential pressure across the filter when the unit is not in operation in order to prevent the filter cake from dropping off the filter elements. A minimum recirculation rate of 0.1 gallon per minute per square foot of filter area shall be provided.

5.3.c.8.D. Septum or filter element -- the filter elements shall be structurally capable of withstanding maximum pressure and velocity variations during filtration and backwash cycles, and shall be spaced such that no less than one (1) inch is provided between elements or between any element and a wall.

5.3.c.8.E. Inlet design - The filter influent shall be designed to prevent scour of the diatomaceous earth from the filter element.

5.3.c.9. Backwash -- A satisfactory method to thoroughly remove and dispose of spent filter cake shall be provided.

5.3.c.10. Appurtenances -- The following shall be provided for every

filter: sampling taps for raw and filtered water; loss of head or differential pressure gauge; a rate-of-flow indicator, preferably with a totalizer; and a throttling valve used to reduce rates below normal during adverse raw water conditions.

5.3.d. Slow rate gravity filters -- The use of slow rate gravity filters shall require prior engineering studies to demonstrate the adequacy and suitability of this method of filtration for the specific raw water supply.

5.3.d.1. Quality of raw water -- Slow rate gravity filtration shall be limited to waters having maximum turbidities of fifty (50) NTU and maximum color of thirty (30) units; such turbidity shall not be attributable to colloidal clay. Raw water quality data shall include examinations for algae.

5.3.d.2. Number -- At least two (2) units shall be provided. Where only two (2) units are provided, each shall be capable of meeting the plant design capacity (normally the projected maximum daily demand) at the approved filtration rate. Where more than two (2) filter units are provided, the filters shall be capable of meeting the plant design capacity at the approved filtration rate with one (1) filter removed from service.

5.3.d.3. Structural details and hydraulics -- Slow rate gravity filters shall be so designed as to provide: a cover; a minimum eight (8) feet of headroom to permit normal movement by operation personnel for scraping and sand removal operations; adequate manholes and access ports for handling of sand; filtration to waste; and an overflow at the maximum filter water level.

5.3.d.4. Rates of filtration -- The permissible rates of filtration shall be determined by the quality of the raw water and shall be on the basis of experimental data derived from the water to be treated. The nominal rate may be forty-five (45) to one hundred fifty (150) gallons per day per square foot of sand area, with somewhat higher rates acceptable when demonstrated to the satisfaction of the Environmental Engineering Division.

5.3.d.5. 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 underdrain will not exceed 0.75 feet per second. The maximum spacing of laterals shall not exceed three (3) feet if pipe laterals are used.

5.3.d.6. Filtering material -- Filter sand shall be placed on graded gravel layers for a minimum depth of thirty (30) inches. The effective size shall be between 0.30 mm and 0.45 mm. The uniformity coefficient shall not exceed 2.5. The sand shall be clean and free from foreign matter.

5.3.d.7. Filter gravel -- The supporting gravel shall conform to the size and depth distribution provided for rapid rate gravity filters.

5.3.d.8. Depth of water on filter beds -- The design shall provide a depth

of at least three (3) feet of water over the sand. Influent water shall not scour the sand surface.

5.3.d.9. Control appurtenances -- Each filter shall be equipped with: a loss of head gauge; an orifice; Venturi meter, or other suitable metering device installed on each filter to control the rate of filtration; and an effluent pipe designed to maintain the water level above the top of the filter sand.

5.3.e. Direct filtration -- Direct filtration, as used in this subdivision, refers to the filtration of a surface water or groundwater determined to be under the direct influence of surface water without prior settling. The nature of the treatment process will depend upon the raw water quality. In-plant demonstration studies may be appropriate where conventional treatment plants are converted to direct filtration. Where direct filtration is proposed, an engineering report shall be submitted prior to conducting the pilot plant or in-plant demonstration studies.

5.3.e.1. Engineering report -- The engineering report should include a historical summary of operating conditions and of raw water quality with special reference to fluctuations in quality and possible sources of contamination. The following raw water parameters should be evaluated in the report: color; turbidity; bacterial concentration; microscopic biological organisms; temperature; total solids; chemical characteristics; and additional parameters as required by the Environmental Engineering Division. The report should also include a description of methods and work to be done during a pilot plant study or, where appropriate, an in-plant demonstration study.

5.3.e.2. Pilot plant studies -- After approval of the engineering report, a pilot study or in-plant demonstration study may be required. The study shall be conducted over a sufficient time to treat all expected raw water conditions throughout the year. The study shall emphasize, but not be limited to, the following items: chemical mixing conditions including shear gradients and detention periods; chemical feed rates; use of various coagulants and coagulant aids; flocculation conditions; filtration rates; filter gradation; types of media and depth of media; filter breakthrough conditions; and adverse impact of recycling backwash water due to microorganisms, solids, algae, trihalomethane formation and other similar problems. Prior to the initiation of design plans and specifications, a final report including the engineer's design recommendations shall be submitted to the Environmental Engineering Division. The pilot plant filter shall be of a similar type and operated in the same manner as proposed for full scale operation. The pilot study shall demonstrate the minimum contact time necessary for optimum filtration for each coagulant proposed.

5.3.e.3. Control and operation -- A continuous recording turbidimeter should be installed on each filter effluent line. Additional continuous monitoring equipment to assist in control of coagulant dose may be required by the Environmental Engineering Division.

5.3.e.4. Site requirements -- The plant and design and land ownership surrounding the plant shall allow for the installation of conventional sedimentation basins

should it be found that such are necessary.

5.4. Disinfection -- Chlorine is the preferred disinfecting agent. Chlorination may be accomplished with liquid chlorine, calcium or sodium hypochlorite or chlorine dioxide. Other disinfecting agents may be considered, providing reliable application equipment is available and testing procedures for a residual are recognized in "Standard Methods for the Examination of Water and Wastewater," latest edition. Continuous disinfection is required for all public water supplies. Since disinfection agents other than chlorine usually demonstrate shortcomings when applied to a public water supply, proposals for use of disinfecting agents in combination with chlorine or other than chlorine require approval by the Environmental Engineering Division prior to preparation of final plans and specifications.

5.4.a. Chlorination equipment.

5.4.a.1. Type -- Solution-feed, gas chlorinators or hypochlorite feeders of the positive displacement type shall be provided.

5.4.a.2. Capacity -- The chlorinator capacity shall be such that a free chlorine residual of at least two (2) milligrams per liter can be maintained in the water after contact time of at least thirty (30) minutes for ground water and to meet the CT for surface water when maximum flow rate coincides with anticipated maximum chlorine demand, maximum pH and minimum temperatures. The equipment shall be of such design that it will operate accurately over the desired feeding range. The chlorinator shall be sized so that at normal operation it will be at approximately fifty percent (50%) of capacity.

5.4.a.3. Standby equipment -- Standby equipment of sufficient capacity shall be available to replace the largest unit. Spare parts shall be made available to replace parts subject to wear and breakage. If there is a large difference in feed rates between routine and emergency dosages, a gas metering tube should be provided for each dose range to ensure accurate control of the chlorine feed.

5.4.a.4. Automatic switchover -- Automatic switchover of chlorine cylinders should be provided, where necessary, to assure continuous disinfection.

5.4.a.5. Automatic proportioning -- Automatic proportioning chlorinators will be required where the rate of flow or chlorine demand is not reasonably constant.

5.4.a.6. Eductor -- Each eductor shall be selected for the point of application with particular attention given to the quantity of chlorine to be added, the maximum injector water flow, the total discharge back pressure, the injector operating pressure, and the size of the chlorine solution line. Gauges for measuring water pressure and vacuum at the inlet and outlet of each eductor should be provided.

5.4.a.7. Injector/diffuser -- The chlorine solution injector/diffuser shall be compatible with the point of application to provide a rapid and thorough mix with all the water being treated. The center of a pipeline is the preferred application point.

5.4.a.8. Scales -- Scales for weighing cylinders shall be provided at all waterworks using chlorine gas. At large waterworks, scales of the indicating and recording type are recommended. Scales shall be recessed unless they are of the low platform type.

5.4.b. Contact time and point of application

5.4.b.1. Due consideration shall be given to the contact time of the chlorine in water with relation to pH, ammonia, taste-producing substances, temperature, bacterial quality, trihalomethane formation potential and other pertinent factors. Chlorine should be applied at a point that will provide adequate contact time. All basins used for disinfection shall be designed to minimize short circuiting.

5.4.b.2. At plants treating surface water, provisions should be made for applying chlorine to the settled water, filtered water, and water entering the distribution system. The contact time as required shall be provided after filtration.

5.4.b.3. As a minimum, at plants treating groundwater only, provisions should be made for applying chlorine to the detention basin inlet and water entering the distribution system.

5.4.b.4. Free residual chlorination is the preferred practice. A minimum contact time of thirty (30) minutes is required for ground water sources not influenced by surface waters. The minimum contact time for surface water sources and ground water sources influenced by surface waters shall be determined by "CT Calculations." Details for calculating "CT" values are contained in the West Virginia Administrative Rules, Division of Health, Public Water Systems, 64CSR3.

5.4.c. Residual chlorine -- Minimum total chlorine residual at all points in a water distribution system shall be 0.2 milligrams per liter. Higher residuals may be required depending on pH, temperature and other characteristics of the water. Booster chlorination may be required to maintain proper residuals.

5.4.d. Testing equipment -- Chlorine residual test equipment recognized in the latest edition of "Standard Methods for the Examination of Water and Wastewater" shall be provided and should be capable of measuring residuals as contained in the West Virginia Administrative Rules, Division of Health, Public Water Systems, 64CSR3. Automatic chlorine residual recorders should be provided where the chlorine demand varies appreciably over a short period of time. All surface water treatment plants designed to serve three thousand (3,300) people or more shall be equipped with recording chlorine analyzers and continuous recorders monitoring water entering the distribution system.

5.4.e. Chlorinator piping.

5.4.e.1. Cross-connection protection -- The chlorinator water supply piping shall be designed to prevent contamination of the treated water supply by sources of questionable quality. At all facilities treating surface water, pre- and post-chlorination systems

shall be independent to prevent possible siphoning of partially treated water into the clear well. The water supply to each eductor shall have a separate shut-off valve. No master shut-off valve is allowed.

5.4.e.2. Pipe material -- The pipes carrying elemental liquid or dry gaseous chlorine under pressure shall be Schedule eighty (80) seamless steel tubing or other materials recommended by the Chlorine Institute (never use PVC). Rubber, PVC, polyethylene, or other materials recommended by the Chlorine Institute shall be used for chlorine solution piping and fittings. Nylon products are not acceptable for any part of the chlorine solution piping system.

5.5. Softening -- The softening process selected shall be based upon the mineral qualities of the raw water and the desired finished water quality in conjunction with requirements for disposal of sludge or brine waste, cost of plant, cost of chemicals and plant location. Applicability of the process chosen shall be demonstrated.

5.5.a. Lime or lime-soda process -- Design standards for rapid mix, flocculation and sedimentation are in "Clarification," subsection 5.2 of this rule. Additional consideration shall be given to the following process elements.

5.5.a.1. Hydraulics -- When split treatment is used, the bypass line should be sized to carry total plant flow, and an accurate means of measuring and splitting the flow shall be provided.

5.5.a.2. Aeration -- Determinations should be made for the carbon dioxide content of the raw water. When concentrations exceed ten (10) milligrams per liter, the economics of removal by aeration as opposed to removal with lime should be considered if it has been determined that dissolved oxygen in the finished water will not cause corrosion problems in the distribution system.

5.5.a.3. Chemical feed point -- Lime and recycled sludge should be fed directly into the rapid mix basin.

5.5.a.4. Rapid mix -- Rapid mix basins shall provide not more than thirty (30) seconds detention time with adequate velocity gradients to keep the lime particles dispersed.

5.5.a.5. Stabilization -- Equipment for stabilization of water softened by the lime or lime-soda process is required.

5.5.a.6. Sludge collection -- Mechanical sludge removal equipment shall be provided in the sedimentation basin. Sludge recycling to the rapid mix should be provided not to exceed a rate of ten percent (10%) of the incoming flow.

5.5.a.7. Sludge disposal -- Provisions shall be included for proper disposal of softening sludge.

5.5.a.8. Disinfection -- The use of excess lime is not an acceptable substitute for disinfection.

5.5.a.9. Plant start-up -- The plant processes shall be manually started following shut-down.

5.5.b. Cation exchange process -- Alternative methods of hardness reduction should be investigated when the sodium content and dissolved solids concentration is of concern.

5.5.b.1. Pre-treatment requirements -- Iron, manganese, or a combination of the two, should not exceed 0.3 milligrams per liter in the water as applied to the ion exchange resin. Pre-treatment is required when the content of iron, manganese, or a combination of the two (2), is one (1) milligram per liter or more. Waters having five (5) units or more turbidity should not be applied directly to the cation exchange softener.

5.5.b.2. Design -- The units may be of pressure or gravity type, of either an upflow or downflow design. Automatic regeneration based on volume of water softened should be used unless manual regeneration is justified and is approved by the Environmental Engineering Division. A manual override shall be provided on all automatic controls.

5.5.b.3. Exchange capacity -- The design capacity for hardness removal should not exceed twenty thousand (20,000) grains per cubic foot when resin is regenerated with 0.3 pounds of salt per kilogram of hardness removed.

5.5.b.4. Depth of resin -- The depth of the exchange resin should not be less than three (3) feet.

5.5.b.5. Flow rates -- The rate of softening should not exceed seven (7) gallons per minute per square foot of bed area, and the backwash rate should be six (6) to eight (8) gallons per minute per square foot of bed area. Rate-of-flow controllers or the equivalent shall be installed for the above purposes.

5.5.b.6. Freeboard -- The freeboard will depend upon the specific gravity of the resin and the direction of water flow. Generally, the washwater collector should be twenty-four (24) inches above the top of the resin on downflow units.

5.5.b.7. Underdrains and supporting gravel -- The bottoms, strainer systems and support for the exchange resin shall conform to criteria provided for rapid rate gravity filters.

5.5.b.8. Brine distribution -- Facilities should be included for even distribution of the brine over the entire surface of both upflow and downflow units.

5.5.b.9. Cross-connection control -- Backwash, rinse and air relief discharge pipes should be installed in such a manner as to prevent any possibility of back-

siphonage.

5.5.b.10. Bypass piping and equipment – A bypass shall be provided around softening units to produce a blended water of desirable hardness.

5.5.b.11. Additional limitations -- Silica gel resins should not be used for waters having a pH above 8.4 or containing less than six (6) milligrams per liter silica and should not be used when iron is present. When the applied water contains a chlorine residual, the cation exchange resin shall be a type that is not damaged by residual chlorine. Phenolic resin should not be used.

5.5.b.12. Sampling taps – Smooth-nose sampling taps shall be provided for the collection of representative samples. The taps shall be located to provide for sampling of the softener influent. effluent and blended water. The sampling taps for the blended water shall be at least twenty (20) feet downstream from the point of blending. Petcocks are not acceptable as sampling taps. Sampling taps should be provided on the brine tank discharge piping.

5.5.b.13. Brine and salt storage tanks.

5.5.b.13.A. Salt dissolving or brine tanks and wet salt storage tanks shall be covered and shall be corrosion-resistant.

5.5.b.13.B. The make-up water inlet shall be protected from back-siphonage. Water for filling the tank should be distributed over the entire surface by pipes above the maximum brine level in the tank. The tanks should be provided with an automatic declining level control system on the make-up water line.

5.5.b.13.C. Wet salt storage basins shall be equipped with manholes or hatchways for access and for direct dumping of salt from truck or rail car. Openings shall be provided with raised curbs and watertight covers having overlapping edges similar to those required for finished water reservoirs.

5.5.b.13.D. Overflows, where provided, shall be protected with corrosion resistant screens and shall terminate with either a turned down bend having a proper free fall discharge or a self-closing flap valve.

5.5.b.13.E. Two wet salt storage tanks or compartments designed to operate independently should be provided.

5.5.b.13.F. The salt shall be supported on graduated layers of gravel placed over a brine collection system.

5.5.b.13.G. Alternative designs that are conductive to frequent cleaning of the wet salt storage tank may be considered.

5.5.b.14. Salt and brine storage capacity -- Reserve salt and brine storage capacity for at least thirty (30) days of operation shall be available.

5.5.b.15. Brine pump or eductor -- An eductor may be used to transfer brine from the brine tank to the softeners. If a pump is used, a brine measuring tank or means of metering should be provided to obtain proper dilution.

5.5.b.16. Stabilization -- Stabilization for corrosion control shall be provided. An alkali feeder shall be provided except when exempted by the Environmental Engineering Division.

5.5.b.17. Waste disposal -- Suitable disposal shall be provided for brine waste. Where the volume of spent brine shall be reduced, consideration may be given to using a part of the spent brine for a subsequent regeneration.

5.5.b.18. Construction materials -- Pipes and contact materials shall be resistant to the aggressiveness of salt. Plastic and red brass are acceptable piping materials. Steel and concrete shall be coated with a non-leaching protective coating that is compatible with salt and brine.

5.5.b.19. Housing -- Bagged salt and dry bulk salt storage shall be enclosed and separated from other operating areas in order to prevent damage to equipment.

5.6 Aeration -- Aeration may be used to help remove offensive tastes and odors due to dissolved gases from decomposing organic matter, to reduce or remove objectionable amounts of carbon dioxide, hydrogen sulfide, etc., and to introduce oxygen to assist in iron or manganese removal, or both. The packed tower aeration process is an aeration process applicable to removal of volatile organic contaminants.

5.6.a. Natural draft aeration -- The design shall provide: perforations in the distribution pan 3/16 to ½ inches in diameter, spaced one (1) to three (3) inches on centers to maintain a six (6) inch water depth, and eight (8) to ten (10) inches of inert media, such as coke or limestone that will not disintegrate due to freezing cycles; distribution of water uniformly over the top tray and discharge through a series of three (3) or more trays with separation of trays not less than twelve (12) inches; loading at a rate of one (1) to five (5) gallons per minute for each square foot of total tray area; trays with slotted, heavy wire (½ inch openings) mesh or perforated bottoms and construction of durable material resistant to aggressiveness of the water and dissolved gases; protection from loss of spray water by wind carriage by enclosure with louvers sloped to the inside at an angle of approximately forty-five (45) degrees; protection from insects by twenty-four (24) mesh screen; and disinfection treatment of aerated water.

5.6.b. Forced or induced draft aeration -- Forced or induced draft aeration devices shall be designed to: include a blower with a weatherproof motor in a tight housing and screened enclosure and ensure adequate counter current of air through the enclosed aerator column; exhaust air directly to the outside atmosphere; include a down-turned and

twenty-four (24)-mesh screened air outlet and inlet; be such that air introduced in the column shall be as free from obnoxious fumes, dust, and dirt as possible; be such that sections of the aerator can be easily reached or removed for maintenance of the interior or installed in a separate aerator room; provide loading at a rate of one (1) to five (5) gallons per minute for each square foot of total tray area; ensure that the water outlet is adequately sealed to prevent unwarranted loss of air; discharge though a series of five or more trays with separation of trays not less than six (6) inches; provide distribution of water uniformly over the top tray; and be of durable material resistant to the aggressiveness of the water and dissolved gases.

5.6.c. Pressure aeration -- Pressure aeration may be used for oxidation purposes only if the pilot plant study indicates the method is applicable; it is not acceptable 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 give thorough mixing of compressed air with water being treated and provide screened and filtered air, free of obnoxious fumes, dust, dirt and other contaminants.

5.6.d. Packed Tower Aeration -- Packed tower aeration (PTA) that is also known as air stripping involves passing water down through a column of packing material while pumping air counter-currently up through the packing. PTA is used for the removal of volatile organic chemicals, trihalomethanes, carbon dioxide, and radon. Generally, PTA is feasible for compounds with a Henry's Constant greater than one hundred (100) (expressed in atm mol/mol - at twelve (12) degrees C), but not normally feasible for removing compounds with a Henry's Constant less than ten (10). For values between ten (10) and one hundred (100), PTA may be feasible but should be extensively evaluated using pilot studies. Values for Henry's Constant should be discussed with the Environmental Engineering Division prior to final design.

5.6.d.1. Process Design.

5.6.d.1.A. Process design methods for PTA involve the determination of Henry's Constant for the contaminant, the mass transfer coefficient, air pressure drop and stripping factor. The applicant shall provide justification for the design parameters selected (i.e., height and diameter of the unit, air to water ratio, packing depth, surface loading rate, etc.). Pilot plant testing shall be provided. The pilot test shall evaluate a variety of loading rates and air to water ratios at the peak contaminant concentration. Special consideration should be given to removal efficiencies when multiple contaminations occur. Where there is considerable past performance data on the contaminant to be treated and there is a concentration level similar to previous projects, the Environmental Engineering Division may approve the process design based on use of appropriate calculations without pilot testing. Proposals of this type shall be discussed with the Environmental Engineering Division prior to submission of any permit applications.

5.6.d.1.B. The tower shall be designed to reduce contaminants to below the maximum contaminant level (MCL) and to the lowest practical level.

5.6.d.1.C. The ratio of the column diameter to packing should be at

least seven (7) to one (1) for the pilot unit and at least ten (10) to one (1) for the full scale tower. The type and size of the packing used in the full scale unit shall be the same as that used in the pilot work.

5.6.d.1.D. The minimum volumetric air to water ratio at peak water flow should be twenty-five (25) to one (1). The maximum air to water ratio for which credit will be given is eighty (80) to one (1).

5.6.d.1.E. The design should consider potential fouling problems from calcium carbonate, manganese and iron precipitation and from bacterial growth. It may be necessary to provide pretreatment. Disinfection capability shall be provided prior to and after PTA.

5.6.d.1.F. The effects of temperature should be considered since a drop in water temperature can result in a drop in contaminant removal efficiency.

5.6.d.2. Materials of Construction -- The tower may be constructed of stainless steel, concrete, aluminum, fiberglass or plastic. Uncoated carbon steel is not recommended because of corrosion. Towers constructed of light-weight materials should be provided with adequate support to prevent damage from wind. Packing materials shall be resistant to the aggressiveness of the water, dissolved gases and cleaning materials and shall be suitable for contact with potable water.

5.6.d.3. Water Flow System -- Water should be distributed uniformly at the top of the tower using spray nozzles or orifice-type distributor trays that prevent short circuiting. A mist eliminator shall be provided above the water distributor system. A side wiper redistribution ring should be provided at least every ten (10) feet in order to prevent water channeling along the tower wall and short circuiting. Smooth nosed sample taps shall be provided in the influent and effluent piping. The effluent sump, if provided, shall have easy access for cleaning purposes and be equipped with a drain valve. The drain shall not be connected directly to any storm or sanitary sewer. A blow-off line should be provided in the effluent piping to allow for discharge of water and chemicals used to clean the tower. The design shall prevent freezing of the influent riser and effluent piping when the unit is not operating. If piping is buried, it shall be maintained under positive pressure. The water flow to each tower shall be metered. An overflow line shall be provided that discharges twelve (12) to fourteen (14) inches above a splash pad or drainage inlet. Proper drainage shall be provided to prevent flooding of the area.

5.6.d.4. Air Flow System -- The air inlet to the blower and tower discharge vent shall be protected with a non-corrodible twenty-four (24) mesh downturned screen to prevent contamination from extraneous matter. The air inlet shall be in a protected location. An air flow meter shall be provided on the influent air line or an alternative method to determine the air flow shall be provided. A backup motor for the air blower shall be readily available.

5.6.d.5. Other Features that Shall Be Provided -- The following shall be

provided: a sufficient number of access ports with a minimum diameter of twenty-four (24) inches to facilitate inspection, media replacement, media cleaning and maintenance of the interior; a method of cleaning the packing material when iron, manganese, or calcium carbonate fouling may occur; tower effluent collection and pumping wells constructed to clearwell standards; provisions for extending the tower height; an Environmental Engineering Division approved alternative supply during periods of maintenance and operation interruptions; no bypass unless specifically approved by the Environmental Engineering Division; disinfection application points both ahead of and after the tower to control biological growth; disinfection and adequate contact time after the water has passed through the tower and prior to the distribution system; adequate packing support to allow free flow of water and to prevent deformation with deep packing heights; adequate foundation to support the tower and lateral support to prevent overturning due to wind loading; fencing and locking gate to prevent vandalism; an access ladder with safety cage for inspection of the aerator including the exhaust port and de-mister; and electrical interconnection to allow simultaneous operation and disconnect of the blower, disinfectant feeder and well pump.

5.6.d.6. Environmental Factors -- The applicant shall contact the appropriate air quality office to determine if permits are required under the Clean Air Act. Noise control facilities should be provided on PTA systems located in residential areas.

5.6.e. Other methods of aeration -- Other methods of aeration may be used if applicable to the treatment needs. Such methods include but are not restricted to spraying, diffused air, cascades and mechanical aeration. The treatment process shall be designed to meet the particular needs of the water to be treated and is subject to the approval of the Environmental Engineering Division.

5.6.f. Protection of aerators -- All aerators except those discharging to lime softening or clarification plants shall be protected from contamination by birds, insects, wind borne debris, rainfall and water draining off the exterior of the aerator.

5.6.g. Bypass -- A bypass should be provided for all aeration units except those installed to comply with maximum contaminant levels.

5.6.h. Corrosion control -- The aggressiveness of the water after aeration should be determined and corrected by additional treatment, if necessary.

5.7. 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 one (1) or more treatment processes shall meet specific local conditions as determined by engineering investigations, including chemical analyses of representative samples of water to be treated, and receive the approval of the Environmental Engineering Division. It may be necessary to operate a pilot plant in order to gather all information pertinent to the design. Consideration should be given to adjusting the pH of the raw water to optimize the chemical reaction. Testing equipment and sampling taps shall be provided.

5.7.a. Removal by oxidation, detention and filtration.

5.7.a.1. Oxidation -- Oxidation may be by aeration or by chemical oxidation with chlorine, potassium permanganate, ozone or chlorine dioxide.

5.7.a.2. Detention.

5.7.a.2.A. Reaction -- A minimum detention time of twenty (20) minutes shall be provided following aeration to insure that the oxidation reactions are as complete as possible. This minimum detention may be omitted only where a pilot plant study indicates no need for detention. The detention basin should be designed as a holding tank with no provisions for sludge collection but with sufficient baffling to prevent short circuiting.

5.7.a.2.B. Sedimentation -- 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. Provisions for sludge removal shall be made.

5.7.b. Removal by the lime-soda softening process.

5.7.c. Removal by manganese greensand filtration -- This process, consists of feeding of potassium permanganate to a manganese greensand filter. Provisions should be made to apply the permanganate as far ahead of the filter as practical and to a point immediately before the filter. 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. An anthracite media cap of at least six inches shall be provided over manganese greensand. The normal filtration rate is three (3) gallons per minute per square foot or not to exceed the rate specified by manufacturer. The normal wash rate is eight (8) to ten (10) gallons per minute per square foot. Air washing should be provided. Smooth nosed sample taps shall be provided prior to application of permanganate, immediately ahead of filtration, at the filter effluent. The smooth nosed sample taps should be provided at points between the anthracite media and the manganese greensand media and halfway down the manganese greensand media. Recommend potassium permanganate feed system have a means of automatic shut-off if overfeed occurs.

5.7.d. Removal by ion exchange -- The ion exchange process of iron and manganese removal should not be used for water containing more than five (5) milligrams per liter of iron, manganese or a combination thereof. This process is not acceptable where either the raw water or wash water contains dissolved oxygen.

5.7.e. Sequestration by polyphosphates -- The sequestration by polyphosphates process shall not be used when iron, manganese or a combination thereof exceeds one (1) milligram per liter as phosphate. Where phosphate treatment is used, satisfactory chlorine residuals shall be maintained in the distribution system. Feeding equipment shall conform to the requirements of "Chemical Application," section six of this rule. Polyphosphates shall not be applied ahead of iron and manganese removal treatment. The

point of application shall be prior to any aeration, oxidation or disinfection if no iron or manganese removal treatment is provided. Phosphate chemicals shall meet AWWA Standards and conform to ANSI/NSF Standard 60: Drinking Water Treatment Chemicals - Health Effects.

5.7.f. Sequestration by sodium silicates -- Sodium silicate sequestration of iron and manganese is appropriate only for groundwater supplies prior to air contact. On-site pilot tests are required to determine the suitability of sodium silicate for the particular water and the minimum feed needed. Rapid oxidation of the metal ions such as by chlorine or chlorine dioxide shall accompany or closely precede the sodium silicate addition. Injection of sodium silicate more than fifteen (15) seconds after oxidation may cause detectable loss of chemical efficiency. Dilution of feed solutions much below five per cent (5%) silica as silica dioxide should also be avoided for the same reason. Sodium silicate addition is applicable to waters containing up to two (2) mg/l of iron, manganese or combination thereof. Chlorine residuals shall be maintained throughout the distribution system to prevent biological breakdown of the sequestered iron. The amount of silicate added shall be limited to twenty (20) mg/l as silica dioxide, but the amount added and naturally occurring silicate shall not exceed sixty (60) mg/l as silica dioxide. Feeding equipment shall conform to the requirements of "Chemical Application," section six of this rule. Sodium silicate shall not be applied ahead of iron or manganese removal treatment. Liquid sodium silicate shall meet AWWA Standard B404 and shall conform to ANSI/NSF Standard 60: Drinking Water Treatment Chemicals - Health Effects.

5.7.g. Sampling taps -- Smooth-nosed 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.

5.7.h. Testing equipment shall be provided for all plants. The equipment should have the capacity to accurately measure the iron content to a minimum of 0.1 milligrams per liter and the manganese content to a minimum of 0.05 milligrams per liter. Where polyphosphate sequestration is practiced, appropriate phosphate testing equipment shall be provided.

5.8. Fluoridation -- Sodium fluoride, sodium silicofluoride and hydrofluosilicic acid shall conform to the applicable AWWA standards and shall conform to ANSI/NSF Standard 60: Drinking Water Treatment Chemicals - Health Effects. Other fluoride compounds that may be available shall be approved by the Environmental Engineering Division. The proposed method of fluoride feed shall be approved by the Environmental Engineering Division prior to preparation of final plans and specifications.

5.8.a. Fluoride compound storage - Fluoride chemicals should be isolated from other chemicals to prevent contamination. Compounds shall be stored in covered or unopened shipping containers and shall be stored inside a building. Storage of hydrofluosilicic acid shall be in sealed carboys unless the treatment plant is designed with bulk storage tanks. While being used, the unsealed storage units for hydrofluosilicic acid shall be vented to the atmosphere at a point outside any building. Bags, fiber drums and deldrums should be stored

on pallets.

5.8.b. Chemical feed equipment and methods -- In addition to the requirements in "Chemical Application," section six of this rule, fluoride feed equipment shall meet the following requirements: scales, loss-of-weight recorders or liquid level indicators, as appropriate, accurate to within five percent (5%) of the average daily change in reading shall be provided for chemical feeds; feeders shall be accurate to within five percent (5%) of any desired feed rate; the fluoride compound shall be fed by a fluoride saturator, volumetric, gravimetric, or hydrofluosilicic acid fifteen (15) gallon carboy or fifty-five (55) gallon drum only (solution tanks are not permitted, exclusive of saturators); fluoride compound shall be added last, either directly into the clearwell or into the plant discharge line; the point of application for hydrofluosilicic acid or sodium fluoride, if into a horizontal pipe, shall be forty-five (45) degrees from the bottom of the pipe with the injector protruding into the pipe 1/3 the pipe diameter; a fluoride solution shall be applied by a positive displacement pump having a stroke rate not less than twenty (20) strokes per minute; anti-siphon devices shall be provided for all fluoride lines and dilution water lines; a device to measure the flow of water to be treated is required; water used for sodium fluoride saturated solution shall be softened if hardness exceeds one hundred (100) mg/l as calcium carbonate; fluoride solutions shall not be injected to a point of negative pressure; the electrical outlet used for the fluoride feed pump shall have a nonstandard receptacle, unless it would void the pump warranty, and shall be interconnected with the well or high service pump; saturators should be of the upflow type and be provided with a meter and backflow protection on the makeup water line.

5.8.c. Secondary controls -- Secondary control systems for fluoride chemical feed devices may be required by the Environmental Engineering Division as a means of reducing the possibility for overfeed; these may include flow or pressure switches or other devices.

5.8.d. Protective equipment -- Protective equipment as recommended by the compound manufacturer shall be provided for operators handling fluoride compounds.

5.8.e. Dust control -- Provision shall be made for the 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 that may enter the room in which the equipment is installed. The enclosure shall be provided with an exhaust fan and dust filter that place the hopper under a negative pressure. Air exhausted from fluoride handling equipment shall discharge through a dust filter to the atmosphere outside of the building. Provision shall be made for disposing of empty bags, drums or barrels in a manner that will minimize exposure to fluoride dusts. A floor drain should be provided to facilitate the hosing of floors.

5.8.f. Testing equipment -- Equipment shall be provided for measuring the quantity of fluoride in the water. Such equipment shall be subject to the approval of the Environmental Engineering Division.

5.9. Stabilization -- Water that is unstable due either to natural causes or to subsequent treatment should be stabilized.

5.9.a. Carbon dioxide addition -- Recarbonation basin design should provide a total detention time of twenty minutes. Two compartments, with a depth that will provide a diffuser submergence of not less than 7.5 feet nor greater submergence than recommended by the manufacturer as follows: a mixing compartment having a detention time of at least three minutes and a reaction compartment. Plants generating carbon dioxide from combustion shall have open top recarbonation tanks in order to dissipate carbon monoxide gas. Where liquid carbon dioxide is used, adequate precautions shall be taken to prevent carbon dioxide from entering the plant from the recarbonation process. Provisions shall be made for draining the carbonation basin and removing sludge.

5.9.b. Acid addition -- Feed equipment shall conform to "Chemical Application" section. Adequate precautions shall be taken for operator safety, such as not adding water to the concentrated acid.

5.9.c. Phosphates -- The feeding of phosphates may be applicable for sequestering calcium in lime-softened water, corrosion control, and in conjunction with alkali feed following ion exchange softening. Feed equipment shall conform to "Chemical Application," section six of this rule. Phosphate shall meet AWWA standards and shall conform to ANSI/NSF Standard 60: Drinking Water Treatment Chemicals - Health Effects. Stock phosphate solution shall be kept covered and disinfected by carrying approximately ten (10) milligrams per liter free chlorine residual. Phosphate solutions having a pH of two (2) or less may be exempted from this requirement by the Environmental Engineering Division. Satisfactory chlorine residuals shall be maintained in the distribution system when phosphates are used.

5.9.d. "Split treatment" -- Under some conditions, a lime-softening water treatment plant can be designed using "split treatment" in which raw water is blended with lime-softened water to partially stabilize the water prior to secondary clarification and filtration. Treatment plants designed to utilize "split treatment" should also contain facilities for further stabilization by other methods.

5.9.e. Alkali feed -- Unstable water created by ion exchange softening shall be stabilized by an alkali feed. An alkali feeder shall be provided for all ion exchange water softening plants except when exempted by the Environmental Engineering Division.

5.9.f. Carbon dioxide reduction by aeration -- The carbon dioxide content of an aggressive water may be reduced by aeration.

5.9.g. Other treatment -- Other treatment for controlling corrosive waters by the use of sodium silicate and sodium bicarbonate may be used where necessary. Any proprietary compound shall receive the specific approval of the Environmental Engineering Division before use.

5.9.h. Water unstable due to biochemical action in distribution system -- Unstable water resulting from the bacterial decomposition of organic matter in water (especially in dead end mains), the biochemical action within tubercles, and the reduction of

sulfates to sulfides should be prevented by the maintenance of a free chlorine residual throughout the distribution system.

5.9.i. Control -- Laboratory equipment shall be provided for determining the effectiveness of stabilization treatment.

5.9.j. Cathodic Protection -- Cathodic protection may be used to prevent or minimize corrosion of the inner surfaces of water tanks and stand pipes and the outer surfaces of metal conduits.

5.10. Taste and Odor Control -- Provision shall be made for the control of taste and odor at all surface water treatment plants. Chemicals shall be added sufficiently ahead of other treatment processes to assure adequate contact time for an effective and economical use of the chemicals. Where severe taste and odor problems are encountered, in-plant or pilot plant, or both, studies are required.

5.10.a. Flexibility -- Plants treating water that is known to have taste and odor problems should be provided with equipment that makes several of the control processes available so that the operator will have flexibility in operation.

5.10.b. Chlorination -- Chlorination can be used for the removal of some objectionable odors. Adequate contact time shall be provided to complete the chemical reactions involved. Excessive potential trihalomethane production through this process should be avoided by adequate bench-scale testing prior to the design.

5.10.c. Chlorine dioxide -- Chlorine dioxide has been generally recognized as a treatment for tastes caused by industrial wastes, such as phenols. However, chlorine dioxide can be used in the treatment of any taste and odor that is treatable by an oxidizing compound. Provisions shall be made for proper storing and handling of the sodium chlorite, so as to eliminate any danger of explosion.

5.10.d. Powdered activated carbon -- Powdered activated carbon should be added as early as possible in the treatment process to provide maximum contact time. Flexibility to allow the addition of carbon at several points is preferred. Activated carbon should not be applied near the point of chlorine application or any other oxidant. The carbon can be added as a pre-mixed slurry or by means of a dry-feed machine as long as the carbon is properly wetted. Continuous agitation or re-suspension equipment is necessary to keep the carbon from depositing in the slurry storage tank. Provision shall be made for adequate dust control. The required rate of feed of carbon in a water treatment plant depends upon the tastes and odors involved, but provision should be made for adding from 0.1 milligrams per liter to at least one hundred (100) milligrams per liter. Powdered activated carbon shall be handled as a potentially combustible material. It should be stored in a building or compartment as nearly fireproof as possible. Other chemicals should not be stored in the same compartment. A separate room should be provided for carbon feed installations. Carbon feeder rooms should be equipped with explosion-proof electrical outlets, lights and motors.

5.10.e. Granular activated carbon -- See "Filtration," subsection 5.3 of this rule, for application within filters.

5.10.f. Copper sulfate and other copper compounds -- Continuous or periodic treatment of water with copper compounds to kill algae or other growths shall be controlled to prevent copper in excess of one (1) milligram per liter as copper in the plant effluent or distribution system. Care shall be taken to assure an even distribution.

5.10.g. Aeration -- See "Aeration," subsection 5.6 of this section.

5.10.h. Potassium permanganate -- Application of potassium permanganate may be considered, providing the treatment shall be designed so that the products of the reaction are not visible in the finished water.

5.10.i. Ozone -- Ozonation may be used as a means of taste and odor control. Adequate contact time shall be provided to complete the chemical reactions involved. Ozone is generally more desirable for treating water with high threshold odors.

5.10.j. Other methods -- The decision to use any other methods of taste and odor control should be made only after careful laboratory or pilot plant, or both, tests and in consultation with the Environmental Engineering Division.

5.11. Microscreening -- A microscreen is a mechanical supplement of treatment capable of removing suspended matter from the water by straining. It may be used to reduce nuisance organisms and organic loadings. It shall not be used in place of filtration, when filtration is necessary to provide a satisfactory water nor used in place of coagulation in the preparation of water for filtration.

5.11.a. Design -- Design shall give due consideration to: the nature of the suspended matter to be removed corrosiveness of the water, the effect of chlorination, when required as pre-treatment; and the duplication of units for continuous operation during equipment maintenance. Design shall provide a durable, corrosion-resistant screen, by-pass arrangements, protection against back-siphonage when potable water is used for washing, and proper disposal of wash waters.

5.12. Waste Handling and Disposal -- Provisions shall be made for proper disposal of water treatment plant waste such as sanitary, laboratory, clarification sludge, softening sludge, iron sludge, filter backwash water, and brines. All waste discharges shall be governed by West Virginia Department of Environmental Protection (WVDEP) requirements. The requirements outlined herein shall, therefore, be considered minimum requirements as WVDEP may have more stringent requirements. In locating waste disposal facilities, due consideration shall be given to preventing potential contamination of the water supply. Alternative methods of water treatment and chemical use should be considered as a means of reducing waste volumes and the associated handling and disposal problems.

5.12.a. Sanitary waste -- The sanitary waste from water treatment plants,

pumping stations, and other waterworks installations shall receive treatment. Waste from these facilities shall be discharged directly to a sanitary sewer system, when available and feasible, to an adequate on-site waste treatment facility approved by the County Health Department or to a treatment system approved by the Environmental Engineering Division.

5.12.b. Brine waste – Waste from ion exchange plants, demineralization plants, or other plants that produce a brine, may be disposed of by controlled discharge to a stream if adequate dilution is available. Surface water quality requirements of the WVDEP will control the rate of discharge. Except when discharging to large waterways, a holding tank of sufficient size should be provided to allow the brine to be discharged over a twenty-four (24) hour period. Where discharging to a sanitary sewer, a holding tank may be required to prevent the overloading of the sewer or interfering with the waste treatment processes. The effect of brine discharge to sewage lagoons may depend on the rate of evaporation from lagoons.

5.12.c. Lime softening sludge – Sludge from plants using lime to soften water varies in quantity and in chemical characteristics depending on the softening process and the chemical characteristics of the water being softened. Recent studies show that the quantity of sludge produced is much larger than indicated by stoichiometric calculations. Methods of treatment and disposal are as follows:

5.12.c.1. Lagoons -- Temporary lagoons that are cleaned periodically should be designed on the basis of 0.7 acres per million gallons per day per one hundred (100) milligrams per liter of hardness removed based on usable lagoon depth of five feet. This should provide about 2 ½ years storage. At least two (2) but preferably more lagoons shall be provided in order to give flexibility in operation. An acceptable means of final sludge disposal shall be provided. Provisions shall be made for convenient cleaning. Permanent lagoons should have a volume of at least four (4) times that for temporary lagoons. The design of both temporary lagoons and permanent lagoons should provide for: locations free from flooding; when necessary, dikes, deflecting gutters or other means of diverting surface water so that it does not flow into the lagoons; a minimum usable depth of five (5) feet; adequate freeboard of at least two (2) feet; an adjustable decanting device; an effluent sampling point; safety provisions; and parallel operation.

5.12.c.2. The application of liquid lime sludge to farm land should be considered as a method of ultimate disposal. Approval from the WVDEP shall be obtained.

5.12.c.3. Discharge of lime sludge to sanitary sewers should be avoided since it may cause both liquid volume and sludge volume problems at the sewage treatment plant. This method should be used only when the sewerage system has the capability to adequately handle the lime sludge.

5.12.c.4. Mixing of lime sludge with activated sludge waste may be considered as a means of co-disposal.

5.12.c.5. Disposal at a landfill may be done as either a solid or liquid if

the landfill can accept such waste, depending on WVDEP requirements.

5.12.c.6. Mechanical dewatering of sludge may be considered. Pilot studies on a particular plant waste are recommended. The Environmental Engineering Division may require operational data from similar water treatment facilities treating similar raw water and require performance guaranteed specifications for the mechanical equipment.

5.12.c.7. Calcination of sludge may be considered. Pilot studies on a particular plant waste are recommended. The Environmental Engineering Division may require operational data from similar water treatment facilities treating similar raw water and require performance guaranteed specifications for the mechanical equipment.

5.12.c.8. Lime sludge drying beds are not recommended.

5.12.d. Alum sludge -- Lagooning may be used as a method of handling alum sludge. Lagoon size can be calculated using total chemicals used plus a factor for turbidity. Mechanical concentration may be considered. A pilot plant study is required before the design of a mechanical dewatering installation. Freezing changes the nature of alum sludge so that it can be used for fill. Acid treatment of sludge for alum recovery may be a possible alternative. Alum sludge may be discharged to a sanitary sewer; however, initiation of this practice will depend on obtaining approval from the owner of the sewerage system as will as from the Environmental Engineering Division before final designs are made. Lagoons should be designed to produce an effluent satisfactory to the WVDEP and should provide for: locations free from flooding; where necessary, dikes, deflecting gutters or other means of diverting surface water so that it does not flow into the lagoon; a minimum usable depth of five feet; freeboard of at least two (2) feet; an adjustable decanting device; an effluent sampling point; and safety provisions.

5.12.e. "Red water" waste -- Waste filter wash water from iron and manganese removal plants can be disposed of as follows:

5.12.e.1. Sand filters -- Sand filters should have the following features:

5.12.e.1.A. Total filter area, regardless of the volume of water to be handled, should be no less than one hundred (100) square feet. Unless the filter is small enough to be cleaned and returned to service in one (1) day, two (2) or more cells are required.

5.12.e.1.B. The "red water" filter shall have sufficient capacity to contain, above the level of the sand, the entire volume of wash water produced by washing all of the production filters in the plant, unless the production filters are washed on a rotating schedule and the flow through the production filters is regulated by true rate of flow controllers. Then sufficient volume shall be provided to properly dispose of the wash water involved.

5.12.e.1.C. Sufficient filter surface area should be provided so that, during any one (1) filtration cycle, no more than two (2) feet of backwash water will accumulate

over the sand surface.

5.12.e.1.D. The filter should not be subject to flooding by surface runoff or flood waters. Finished grade elevation shall be established to facilitate maintenance, cleaning and removal of surface sand as required. Flash boards or other non-watertight devices shall not be used in the construction of filter side walls.

5.12.e.1.E. The filter media should consist of a minimum of twelve (12) inches of sand, three (3) to four (4) inches of supporting small gravel or torpedo sand and nine (9) inches of gravel in graded layers. All sand and gravel should be washed to remove fines.

5.12.e.1.F. Filter sand should have an effective size of 0.3 to 0.5 mm and a uniformity coefficient not to exceed 3.5. The use of larger sized sands shall be justified by the designing engineer to the satisfaction of the Environmental Engineering Division.

5.12.e.1.G. The filter should be provided with an adequate under-drainage collection system to permit satisfactory discharge of filtrate.

5.12.e.1.H. Provision shall be made for the sampling of the filter effluent.

5.12.e.1.I. Overflow devices from "red water" filters shall not be permitted.

5.12.e.1.J. Where freezing is a problem, provisions should be made for covering the filters during the winter months.

5.12.e.1.K. "Red water" filters shall comply with the common wall provisions that pertain to the possibility of contamination of finished water with an unsafe water. The Environmental Engineering Division shall be contacted for approval of any arrangement where a separate structure is not provided.

5.12.e.2. Lagoons -- Lagoons shall have the following features: be designed with volume ten (10) times the total quantity of wash water discharged during any twenty-four (24) hour period; a minimum usable depth of three (3) feet, length four (4) times width, and the width at least three (3) times the depth, as measured at the operating water level; an outlet at the end opposite the inlet; a weir overflow device at the outlet end with weir length equal to or greater than depth; and velocity dissipated at the inlet end.

5.12.e.3. Discharge to community sanitary sewer -- "Red water" may be discharged to a community sewer; however, approval of this method will depend on obtaining approval from the owner of the sewerage system as well as from the Environmental Engineering Division before final designs are made. A holding tank is recommended to prevent overloading the sewers.

5.12.e.4. Recycling "Red Water" waste -- Recycling of supernatant or filtrate from "red water" waste treatment facilities to the head end of an iron removal plant is not allowed except as approved by the Environmental Engineering Division.

5.12.f. Waste filter wash water -- Waste filter wash water from surface water treatment or lime softening plants should have suspended solids reduced to a level acceptable to the WVDEP before being discharged. Many plants have constructed holding facilities and return this water to the inlet end of the plant. The holding facility should be of such a size that it will contain the anticipated volume of waste wash water produced by the plant when operating at design capacity. A plant that has two (2) filters should have a holding facility that will contain the total waste wash from both filters calculated by using a fifteen (15) minute wash at twenty (20) gallons per minute per square foot. In plants with more filters, the size of the holding facilities will depend on the anticipated hours of operation. It is required that waste filter wash water be returned at a rate of less than ten percent (10%) of the raw water influent rate. Filter backwash water should not be recycled when the raw water contains excessive algae, when finished water taste and odor problems are encountered, or when trihalomethane levels in the distribution system may exceed allowable levels. Consideration shall be given to the concentration effects of contaminants.

§64-77-6. Chemical Application

6.1. General. -- No chemicals shall be applied to treat drinking waters unless specifically approved by the Environmental Engineering Division.

6.1.a. Plans and specifications. -- Plans and specifications shall be submitted to the Environmental Engineering Division for review and approval and shall include: descriptions of feed equipment, including maximum and minimum feed ranges; location of feeders, piping layout and points of application; storage and handling facilities; specifications for chemicals to be used; operating and control procedures including proposed application rates; and the descriptions of testing equipment and procedures.

6.1.b. Chemical application. -- Chemicals shall be applied to the water at such points and by such means as to assure maximum efficiency of treatment, assure maximum safety to consumers, provide maximum safety to operators, assure satisfactory mixing of the chemicals with the water, provide maximum flexibility of operation through various points of application, when appropriate, and prevent backflow or back-siphonage between multiple points of feed through common manifolds.

6.1.c. General equipment design. -- General equipment design shall be such that: feeders will be able to supply, at all times, the necessary amounts of chemicals at an accurate rate, throughout the range of feed; chemical-contact materials and surfaces are resistant to the aggressiveness of the chemical solution; corrosive chemicals are introduced in such a manner as to minimize potential for corrosion; chemicals that are incompatible are not stored or handled together; all chemicals are conducted from the feeder to the point of application in separate conduits; chemical feeders are as near as practical to the feed point; chemical feeders and pumps operate at no lower than twenty per cent (20%) of the feed range; chemicals are fed by gravity where practical; and all surface water systems have the capability to feed powdered activated carbon.

6.2. Facility Design.

6.2.a. Number of feeders -- Where chemical feed is necessary for the protection of the supply, such as chlorination, coagulation or other essential processes, the standby unit or a combination of units of sufficient capacity shall be available to replace the largest unit during shut-downs, for all surface water and ground water under the direct influence of surface water systems. The standby unit or a combination of units of sufficient capacity should be available to replace the largest unit during shut-downs for other water systems. Where a booster pump is required, duplicate equipment should be provided and, when necessary, standby power. A separate feeder shall be used for each chemical applied. Spare parts shall be available for all equipment to replace parts that are subject to wear and damage.

6.2.b. Control -- Feeders may be manually or automatically controlled, with automatic controls designed to allow override by manual controls. Process shall be manually started following shutdown, unless otherwise approved by the Environmental Engineering

Division. At automatically operated facilities, chemical feeders shall be electrically interconnected with the well or service pump. Chemical feed rates shall be proportional to flow. A means to measure water flow shall be provided in order to determine chemical feed rates. Provisions shall be made for measuring the quantities of chemicals used. Automatic chemical dose or residual analyzers may be approved by the Environmental Engineering Division for use and shall provide alarms for critical values and recording charts.

6.2.b.1. Weighing scales -- Weighing scales shall be provided for weighing cylinders at all plants utilizing chlorine gas. For large plants, indicating and recording type weighing scales are desirable and are required for hydrofluosilicic acid and sodium silicofluoride feed and volumetric dry chemical feeders. Weighing scales shall be accurate to measure increments of 0.5 per cent of load.

6.2.c. Dry chemical feeders. -- Dry chemical feeders shall measure chemicals volumetrically or gravimetrically, provide adequate solution water and agitation of the chemical in the solution pot, provide gravity feed from solution pots, completely enclose chemicals to prevent emission of dust to the operating room and be provided with dust removal systems.

6.2.d. Positive displacement solution pumps. -- Positive displacement type solution feed pumps should be used to feed liquid chemicals but shall not be used to feed chemical slurries unless recommended by the manufacturer for such use. Pumps shall be sized to match or exceed maximum head conditions found at the point of injection.

6.2.e. Liquid chemical feeders. -- Siphon control - Liquid chemical feeders shall be such that chemical solutions cannot be siphoned into the water supply by assuring discharge at a point of positive pressure or by providing vacuum relief, a suitable air gap or other suitable means or combinations as necessary.

6.2.f. Cross-connection control. -- Cross-connection control shall be provided to assure that the service water lines discharging to solution tanks are properly protected from backflow as required by the Environmental Engineering Division, vacuum breakers as a minimum. Design shall prevent liquid chemical solutions from being siphoned through solution feeders into the water supply, and no direct connection shall exist between any sewer and a drain or overflow from the feeder, solution chamber or tank by providing that all drains terminate at least six (6) inches or two (2) pipe diameters, whichever is greater, above the overflow rim of a receiving sump, conduit or waste receptacle.

6.2.g. Chemical feed equipment location. -- Chemical feed equipment shall: be located in a separate room to reduce hazards and dust problems; be conveniently located near points of application to minimize length of feed lines; be readily accessible for servicing, repair, and observation of operation including cleanouts; be located such that the flow to the rapid mix is by gravity, except in case of in-line static mixers; be located with protective curbing so that chemicals from equipment failure, spillage or accidental drainage shall not enter the water in conduits, treatment or storage basins; and have floor drains to facilitate area cleaning.

6.2.h. In-Plant water supply. -- In-plant water supply shall be: only from a safe,

source approved by the Environmental Engineering Division, ample in quantity and adequate in pressure; provided with means for measurement when preparing specific solution concentrations by dilution; properly treated for hardness, when necessary; and properly protected against backflow as approved by the Environmental Engineering Division.

6.2.i. Storage of chemicals -- Space should be provided for at least thirty (30) days of chemical supply, the convenient and efficient handling of chemicals, dry storage conditions, and a minimum storage volume of 1-1/2 truck loads where purchase is by truck load lots. Storage tanks and pipelines for liquid chemicals shall be specific to the chemicals and not for alternates. Where possible connectors for each liquid chemical shall be different and distinctly marked. Chemicals shall be stored in covered or unopened shipping containers, unless the chemical is transferred into a storage unit approved by the Environmental Engineering Division. Liquid chemical storage tanks shall have a liquid level indicator and have an overflow and a receiving basin or drain capable of containing accidental spills or overflows. Special precautions shall be taken with: sodium chlorite, to eliminate any danger of explosion and to avoid heat, flame, moisture and shock; activated carbon, which is a potentially combustible material requiring isolated, fireproof storage and explosion-proof electrical outlets, lights and motors in areas of dry handling; and cylinders of chlorine gas that shall be isolated from operating areas, restrained in position to prevent upset, and stored in rooms separate from ammonia storage.

6.2.j. Solution tanks -- A means shall be provided in a solution tank to maintain a uniform strength of solution. Continuous agitation shall be provided to maintain slurries in suspension. Two (2) solution tanks of adequate volume may be required for a chemical to assure continuity of chemical supply. Means shall be provided to measure the solution level in the tank. Chemical solutions shall be kept covered. Large tanks with access openings shall have such openings curbed and fitted with overhanging covers. Subsurface locations for solution tanks shall be free from sources of possible contamination and assure positive drainage for groundwater, accumulated water, chemical spills and overflows. Overflow pipes, when provided, should be turned downward, with the end screened, have a free fall discharge, and be located where noticeable. Acid storage tanks shall be vented to the outside atmosphere but not through vents in common with day tanks. Each tank shall be provided with a valved drain protected against backflow. Solution tanks shall be located with protective curbing so that chemicals from equipment failure, spillage or accidental drainage shall not enter the water in conduits, treatment or storage basins. Make-up water shall enter the tank from above the maximum solution level, a distance of two (2) pipe diameters but not less than six (6) inches through a smooth nosed tap, or shall be protected with backflow prevention devices approved by the Environmental Engineering Division. Fluoride shall not be made in a solution tank.

6.2.k. Day tanks -- Day tanks shall be provided where bulk storage of liquid chemical is provided. Day tanks shall meet all the requirements of solution tanks. Day tanks should hold no more than a thirty (30) hour supply, but no less than a one (1) day of operation supply at design flow. Day tanks shall be scale-mounted or have a calibrated gauge painted or mounted on the side if liquid level can be observed in a gauge tube, manometer or through translucent sidewalls of the tank. In opaque tanks, a gauge rod extending above a reference

point at the top of the tank, attached to a float, may be used. The ratio of the area of the tank to its height shall be such that unit readings are meaningful in relation to the total amount of chemical fed during a day. Fluoride shall be scale mounted only. Hand pumps may be provided for transfer from a carboy or drum. A tip rack may be used to permit withdrawal into a bucket from a spigot. Where motor-driven transfer pumps are provided, a liquid level limit switch and an over-flow from the day tank shall be provided. Transfer of hydrofluosilicic acid shall not be permitted. A means that is consistent with the nature of the chemical solution shall be provided to maintain uniform strength of solution in a day tank. Continuous agitation shall be provided to maintain chemical slurries in suspension. Tanks shall be properly labeled to designate the chemical contained.

6.2.l. Feed lines -- Feed lines: should be as short as possible, and of durable, corrosion-resistant material, easily accessible throughout the entire length, protected against freezing, and readily cleaned; should slope upward from the chemical source to the feeder when conveying gases; shall be designed consistent with scale-forming or solids depositing properties of the water, chemical, solution or mixtures conveyed; shall be color coded; should introduce corrosive chemicals in such manner as to minimize potential for corrosion; and shall not carry pressurized chlorine gas beyond the chlorine feeder room.

6.2.m. Handling -- Carts, elevators and other appropriate means shall be provided for lifting chemical containers to minimize excessive lifting by operators. Provisions shall be made for disposing of empty bags, drums or barrels by a procedure approved by the Environmental Engineering Division that will minimize exposure to dust. Provision shall be made for the proper transfer of dry chemicals from shipping containers to storage bins or hoppers in such a way as to minimize the quantity of dust that may enter the room in which the equipment is installed. Control should be provided by use of vacuum pneumatic equipment or closed conveyor systems. Facilities should be provided for emptying shipping containers in special enclosures or for exhaust fans and dust filters that put the hoppers or bins under negative pressure. Provision shall be made for measuring quantities of chemicals used to prepare feed solutions. Chemicals that are incompatible shall not be fed, stored or handled together. Precautions shall be taken with electrical equipment to prevent explosions, particularly in the use of sodium chlorite and activated carbon in accordance with the latest NEC.

6.2.n. Housing -- Floor surfaces shall be smooth and impervious, slip-proof and well drained. Vents from feeders, storage facilities and equipment exhaust shall discharge to the outside atmosphere above grade and remote from air intakes and doors. Structures, rooms and areas accommodating chemical feed equipment shall provide convenient access for servicing, repair and observation of the operation. Open basins, tanks and conduits shall be protected from chemical spills or accidental drainage.

6.3. Chemicals.

6.3.a. Shipping containers. -- Chemical shipping containers shall be fully labeled to include chemical name, purity and concentration and supplier name and address. Chemicals having a distinguishing color may be used, providing the coloring material is not

toxic in concentrations used and will not impart taste, odor or color to the water supply.

6.3.b. Specifications. -- Chemicals shall meet AWWA specifications and shall conform to ANSI/NSF Standard 60: Drinking Water Treatment Chemicals - Health Effects where applicable.

6.3.c. Assay. -- Provisions may be required for the assay of chemicals delivered.

6.4. Operator Safety.

6.4.a. Ventilation. -- Special provisions shall be made for ventilation of chlorine feed and storage rooms.

6.4.b. Respiratory protection equipment. -- Respiratory protection equipment, meeting the requirements of the National Institute for Occupational Safety and Health (NIOSH), shall be available where chlorine gas is handled and shall be stored at a convenient location but not inside any room where chlorine is used or stored. The units shall use compressed air, have at least a thirty (30) minute capacity and be compatible with or exactly the same as units used by the fire department responsible for the plant.

6.4.c. Chlorine leak detection. -- A bottle of ammonium hydroxide, fifty-six per cent (56%) ammonia solution, shall be available for chlorine leak detection. Where ton containers are used, a leak repair kit approved by the Chlorine Institute shall be provided. Continuous chlorine leak detection equipment is recommended. Where a leak detector is provided it shall be equipped with both an audible alarm and a warning light.

6.4.d. Protective equipment -- At least one (1) pair of rubber gloves, a dust respirator of a type meeting NIOSH requirements for toxic dusts, an apron or other protective clothing and goggles or face mask shall be provided for each operator. A deluge shower and eye-washing device should be installed where strong acids and alkalis are used or stored. A water holding tank that will allow water to come to room temperature shall be installed in the water line feeding the deluge shower and eye-washing device. Other methods of water tempering will be considered on an individual basis. Other protective equipment should be provided as necessary.

6.4.e. Gases from feeders, storage and equipment exhausts shall be conveyed to the outside atmosphere above grade and remote from air intakes and doors.

6.4.f. A plastic bottle of hydrochloric acid (muriatic acid, in commercial form) shall be available for ammonia leak detection where ammonia gas is used or stored.

6.4.g. Facilities shall be provided for washing of face, gloves and protective equipment.

6.4.h. Safety signs shall be posted in all areas where necessary.

6.5. Specific Chemicals.

6.5.a. Chlorine gas -- Chlorine gas feed and storage shall be enclosed, sealed and separated from other operating areas. The chlorine room shall be provided with a shatter resistant inspection window installed in an interior wall, constructed in such a manner that all openings between the chlorine room and the remainder of the plant are sealed and provided with doors equipped with panic hardware assuring ready means of exit and opening outward only to the building exterior.

6.5.a.1. Full and empty cylinders of chlorine gas shall be isolated from operating areas, restrained in position to prevent upset, stored in rooms separate from ammonia storage and stored in areas not in direct sunlight or exposed to excessive heat.

6.5.a.2. Where chlorine gas is used, adequate housing shall be provided for the chlorination equipment and for storing chlorine. The room shall be constructed to provide the following: a ventilating fan designed specifically to handle chlorine gas with a capacity that provides one complete air change per minute when the room is occupied; the ventilating fan shall take suction near the floor as far as practical from the door and air inlet, with the point of discharge so located as not to contaminate air inlets or entrance doors to any rooms or structures; air inlets should be through louvers near the ceiling; and louvers for chlorine room air intake and exhaust shall facilitate airtight closure. Separate switches for the fan and lights shall be located outside of the chlorine room and at the inspection window. Outside switches shall be protected from vandalism. A signal light indicating fan operation shall be provided at each entrance when the fan can be controlled from more than one point. Vents from feeders and storage shall discharge to the outside atmosphere, above grade. The room location should be on the prevailing downwind side of the building away from entrances, windows, louvers, walkways, etc. Floor drains are discouraged. Where provided, the floor drains shall discharge to the outside of the building and shall not be connected to other internal or external drainage systems.

6.5.a.3. Chlorinator rooms should be heated to sixty (60) degrees F and be protected from excessive heat. Cylinders and gas lines should be protected from temperatures above that of the feed equipment.

6.5.a.4. Pressurized chlorine feed lines shall not carry chlorine gas beyond the chlorinator room.

6.5.b. Acids and caustics -- Acids and caustics shall be kept in closed corrosion-resistant shipping containers or storage units with contents identified by signs or placards. Acids and caustics shall not be handled in open vessels but shall be pumped in undiluted form from original containers through suitable hose to the point of treatment or to a covered day tank.

6.5.c. Sodium chlorite for chlorine dioxide generation. -- Proposals for the storage and use of sodium chlorite shall be approved by the Environmental Engineering Division prior to the preparation of final plans and specifications. Provisions shall be made for

proper storage and handling of sodium chlorite to eliminate any danger of explosion.

6.5.c.1. Storage -- Sodium chlorite shall be stored by itself in a separate room and preferably shall be stored in an outside building detached from the water treatment facility. It shall be stored away from organic materials that would react violently with sodium chlorite. The storage structures shall be constructed of noncombustible materials. If the storage structure is located in an area where a fire may occur, water shall be available to keep the sodium chlorite area cool enough to prevent decomposition from heat and the resultant explosive conditions.

6.5.c.2. Handling -- Care should be taken to prevent spillage. An emergency plan of operation should be available for the clean up of any spillage. Storage drums shall be thoroughly flushed prior to recycling or disposal.

6.5.c.3. Feeders -- Positive displacement feeders shall be provided. Tubing for conveying sodium chlorite or chlorine dioxide solutions shall be Type 1 PVC, polyethylene or materials recommended by the manufacturer. Chemical feeders may be installed in gas chlorine rooms if sufficient space is provided for facilities meeting the chlorine room requirements. Feed lines shall be installed in a manner to prevent formation of gas pockets and shall terminate at a point of positive pressure. Check valves shall be provided to prevent the backflow of chlorine into the sodium chlorite line.

6.6. Other chemical feed system or treatment methodologies may be installed in accordance with manufacturers and industry recommendations if approved by the Environmental Engineering Division.

§64-77-7. Pumping Facilities.

7.1. General. -- Pumping facilities shall be designed to maintain the sanitary quality of pumped water. Subsurface pits or pump rooms and inaccessible installations should be avoided. No pumping station shall be subject to flooding.

7.2. Location. -- The pumping station shall be so located that the proposed site will meet the requirements for sanitary protection of water quality, hydraulics of the system and protection against interruption of service by fire, flood or any other hazard including accumulation of flammable or explosive gasses.

7.2.a. Site protection. -- The pumping station shall be: elevated to a minimum of three feet above the one hundred (100) year flood elevation or protected to such elevations where practical; readily accessible at all times unless permitted to be out of service for the period of inaccessibility; graded around the station so as to drain surface water away from the station; and protected to prevent vandalism and entrance by animals or unauthorized persons.

7.3. Pumping Stations.

7.3.a. Both raw and finished water pumping stations: shall have adequate space for the installation of additional units, if needed, and for the safe servicing of all equipment; be of durable construction, fire and weather resistant and with outward-opening doors; have a floor elevation of at least six (6) inches above finished grade or provide drains or sumps to keep the station floor dry; have underground structure waterproofed; have all floors drained in such a manner that the quality of the potable water will not be endangered; have floors slope to a suitable drain; provide a suitable outlet for drainage from pump glands without discharging onto the floor; provide sampling taps, suction and discharge pressure gauges with stop cocks; and provide metering facilities.

7.3.b. Suction well. -- Suction wells shall be watertight, have floors sloped to permit removal of water and entrained solids, be covered or otherwise protected against contamination and have two pumping compartments or other means to allow the suction well to be taken out of service for inspection, maintenance or repair.

7.3.c. Equipment servicing. -- Pump stations shall be provided with: crane-ways, hoist beams, eye bolts, or other adequate facilities for servicing or removal of pumps, motors or other heavy equipment; openings in floors, roofs or wherever else needed for removal of heavy or bulky equipment; and a convenient tool board, or other facilities as needed, for proper maintenance of the equipment.

7.3.d. Stairways and ladders shall: be provided between all floors and in pits or compartments that are entered; and have handrails on both sides, and treads of non-slip material. Stairs are preferred in areas where there is frequent traffic or where supplies are transported by hand. They shall have risers not exceeding nine (9) inches and treads wide enough for safety.

7.3.e. Heating. -- Provisions shall be made for adequate heating for the comfort of the operator and the safe and efficient operation of the equipment. In pump houses not occupied by personnel, only enough heat need be provided to prevent freezing of equipment or treatment process.

7.3.f. Ventilation. -- Ventilation shall conform to existing local and state codes. Adequate ventilation shall be provided for all pumping stations. Forced ventilation of at least six (6) changes of air per hour shall be provided for all rooms, compartments, pits and other enclosures below the ground floor and any area where unsafe atmosphere may develop or where excessive heat may be built up.

7.3.g. Dehumidification. -- In areas where excess moisture could cause hazards to safety or damage to equipment, means for dehumidification should be provided.

7.3.h. Lighting. -- Pump stations shall be adequately lighted throughout. All electrical work shall conform to the requirements of the AIA and related agencies and to the NEC and the relevant state and local codes.

7.3.i. Sanitary and other conveniences. -- All pumping stations that are manned for extended periods should be provided with potable water, lavatory and toilet facilities. Plumbing shall be so installed as to prevent contamination of a public water supply.

7.4. Ground Water Pump Stations. -- Where pumping facilities are used, wells and springs shall be vented by properly hooded and screened pipe extending at least twelve (12) inches above the pump station floor or ground surface. Where necessary, provision shall be made for lubricating the pump from a point at least six (6) inches above the top of the well cover, by means that will prevent contamination of the water supply.

7.4.a. Driven or Drilled Wells. -- Pumping stations located over driven or drilled wells shall: have riser pipe or casing extending at least six (6) inches, and preferably twelve (12) inches, above the floor, and equipped with a flange or suitable stuffing box; have riser pipe or casing firmly connected to the pump structure or have casing inserted into a recess extending at least one (1) inch into the base of the pump, if a watertight connection is not provided; have the base of the pump not less than six (6) inches above the pump room floor; and have the pump foundation and base designed to prevent water from coming into contact with the joint.

7.4.b. Submersible Pumps. -- Where a submersible pump is used, the top of the casing shall be equipped with pitless adaptors or vents, or both, approved by the NSF or WSC with an approved cap to effectively seal against entrance of water under all conditions of vibration or movements of conductors or cables.

7.4.c. Discharge Piping. -- Discharge piping should be provided with means to pump to waste but shall not be directly connected to a sewer. The discharge line: shall have control valves located above the pump floor; be protected against freezing; be valved to permit testing and control of each well; have watertight joints; and have all exposed valves protected.

7.5. Pumps.

7.5.a. At least two pumping units shall be provided. With any pump out of service, the remaining pump or pumps shall be capable of providing the maximum daily pumping demand of the system. The pumping units shall: have ample capacity to supply the peak demand against the required distribution system pressure without dangerous overloading; be driven by prime movers able to meet the maximum horsepower condition of the pumps; be provided with readily available spare parts and tools; be served by control equipment that has proper heater and overload protection for air temperature encountered; and be able to pump the necessary average demand in a period not to exceed eight (8) hours.

7.5.b. Suction lift. -- Suction lift shall be avoided, if possible, and be within manufacturers specifications, preferably less than fifteen (15) feet. If suction lift is necessary, provision shall be made for priming the pumps.

7.5.c. Priming. -- Priming water shall not be of lesser sanitary quality than that of the water being pumped. Means shall be provided to prevent back siphonage. When an air-operated ejector is used, the screened intake shall draw clean air from a point at least ten (10) feet above the ground or other source of possible contamination unless the air is filtered by an apparatus approved by the Environmental Engineering Division. Vacuum priming may be used.

7.6. Booster Pumps.

7.6.a. Booster pumps stations shall be constructed in accordance with "Pumping Stations," subsection 7.3 of this section, and shall contain sampling taps and sufficient room for booster chlorination facilities.

7.6.b. Booster pumps shall be located or controlled so that they will not produce negative pressure in their suction lines. The intake pressure shall be at least five (5) pounds per square inch when the pump is in normal operation. An automatic cutoff or a low pressure controller shall maintain at least five (5) pounds per square inch in the suction line under all operating conditions. Automatic or remote control devices shall have a range between the start and cutoff pressure that will prevent excessive cycling. A bypass shall be available and provide for needed demand in eight (8) hours or less.

7.6.c. Duplicate pumps. -- Each booster pumping station shall contain not less than two (2) pumps with capacities such that peak demand can be satisfied with the largest pump out of service.

7.6.d. Metering. -- All booster pumping stations shall contain a totalizer meter.

7.6.e. In-line booster pumps. -- In-line booster pumps shall be accessible for servicing and repairs.

7.6.f. Individual home booster pumps. -- Individual home booster pumps shall

not be allowed for any individual service from the public water supply main where residual pressures are less than five (5) pounds per square inch under all flow conditions. Where used, backflow prevention, approved by the Environmental Engineering Division, consisting of at least a double check valve assembly shall be provided by the customer to protect the public water supply.

7.7. Automatic and Remote Controlled Stations. -- All automatic stations should be provided with automatic signaling apparatus that will report when the station is out of service. All remote controlled stations shall be electrically operated and controlled and shall have signaling apparatus of proven performance. Installation of electrical equipment shall conform with the applicable state and local electrical codes and the National Electrical Code.

7.8. Appurtenances.

7.8.a. Valves. -- Pumps shall be adequately valved to permit satisfactory operation, maintenance and repair of the equipment. If foot valves are necessary, they shall have a net valve area of at least 2-1/2 times the area of the suction pipe, and they shall be screened. Each pump shall have a positive-acting check valve on the discharge side between the pump and the shut-off valve.

7.8.b. Piping. -- In general, piping shall: be designed so that the friction losses will be minimized and not be subject to contamination; have watertight joints; be protected against a surge or water hammer; be such that each pump has an individual suction line or lines are so manifolded that they will insure similar hydraulic and operating conditions,

7.8.c. Gauges and meters. -- Each pump shall have a pressure gauge on its discharge line, shall have a compound gauge on its suction line, should have recording meters and gauges in the larger stations (250 gallons per minute or larger) and shall have a means for measuring the discharge volume.

7.8.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 less sanitary quality the seal shall be provided with a break tank open to atmospheric pressure and have an air gap of at least six (6) inches or two (2) pipe diameters, whichever is greater, between the feeder line and the spill line of the tank.

7.8.e. Controls. -- Pumps, their motors and accessories, shall be controlled in such a manner that they will operate at rated capacity without dangerous overload. Where two (2) or more pumps are installed, provision shall be made for alternation. Provision shall be made to prevent energizing the motor in the event of a backspin cycle. Electrical controls shall be installed in accordance with NEC requirements. Equipment shall be provided, or other arrangements shall be made, to prevent surge pressures from activating controls that switch on pumps or activate other equipment outside the normal design cycle of operation.

7.8.f. Standby power. -- Whenever possible, to ensure continuous service when the primary power had been interrupted, a power supply shall be provided from at least two (2)

independent sources or a standby or an auxiliary source shall be provided. If standby power is provided by on-site generators or engines, the fuel storage and fuel line shall be designed to protect the water supply from contamination. Natural gas or bottled gas are the preferred fuels.

7.8.g. Water pre-lubrication. -- When automatic pre-lubrication of pump bearings is necessary and an auxiliary direct drive power supply is provided, the pre-lubrication line shall be provided with a valved bypass around the automatic control so that the bearings can, if necessary, be lubricated manually before the pump is started or the pre-lubrication controls shall be wired to the auxiliary power supply.

§64-77-8. Finished Water Storage.

8.1. General. -- 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. Steel structures shall follow the current AWWA standards concerning steel tanks, standpipes, reservoirs, and elevated tanks wherever they are applicable. Other materials of construction are acceptable when properly designed to meet the requirements of this section.

8.1.a. Sizing. -- Storage facilities should have sufficient capacity, as determined from engineering studies, to meet domestic, commercial and industrial demands, and where fire protection is provided, fire flow demands.

8.1.a.1. Fire flow requirements established by the ISO should be satisfied where fire protection is provided.

8.1.a.2. The minimum storage capacity (or equivalent capacity) for systems providing fire protection shall be equal to twice the average daily demand of one hundred fifty (150) gallons per customer per day plus fire flow unless it can be demonstrated that supply capacity of the system is sufficient to warrant less. This requirement may be reduced when the source and treatment facilities have sufficient capacity with standby power to supplement peak demands of the system.

8.1.a.3. A recommended storage capacity for systems not providing fire protection should be equal to twice the average daily demand of one hundred fifty (150) gallons per customer per day.

8.1.b. Location of ground-level reservoirs -- The bottom of reservoirs and standpipes should be placed at the normal ground surface and shall be above the one hundred (100) year flood level. When the bottom shall be below normal ground surface, it shall be placed above the groundwater table. At least fifty per cent (50%) of the water depth of the reservoir should be above grade. Sewers, drains, standing water, and similar sources of possible contamination should be kept at least fifty (50) feet from the reservoir. A water main pipe, pressure tested in place to fifty (50) pounds per square inch without leakage, may be located from twenty (20) to fifty (50) feet from a sewer, but under no circumstances shall it be located within 20 feet of a sewer.

8.1.c. Protection. -- All finished water storage structures shall have suitable watertight roofs and screened vents that exclude birds, animals, insects, and excessive dust.

8.1.d. Protection from trespassers. -- Fencing, locks on access manholes, and other necessary precautions shall be provided to prevent trespassing, vandalism and sabotage.

8.1.e. Drains. -- No drain on a water storage structure may have a direct connection to a sewer or storm drain. The design shall allow draining the storage facility for cleaning or maintenance without causing loss of pressure in the distribution system.

8.1.f. Overflow. -- All water storage structures shall be provided with an overflow that is brought down to an elevation between twelve (12) and twenty-four (24) inches above the ground surface and that discharges over a drainage inlet structure or a splash plate. No overflow may be connected directly to a sewer or a storm drain. All overflow pipes shall be located so that any discharge is visible.

8.1.f.1. When an internal overflow pipe is used on elevated tanks, it should be located in the access tube. For vertical drops on other types of storage facilities, the overflow pipe should be located on the outside of the structure.

8.1.f.2. The overflow of a ground-level structure shall open downward and be screened with twenty-four (24) mesh non-corrodible screen installed within the pipe at a location least susceptible to damage by vandalism.

8.1.f.3. The overflow pipe shall be of sufficient diameter to permit waste of water in excess of the filling rate.

8.1.g. Access. -- Finished water storage structures shall be designed with reasonably convenient access to the interior for cleaning and maintenance. Manholes above the water line: shall be framed at least four (4) inches, and preferably (6) six inches, above the surface of the roof at the opening; on ground-level structures, shall be elevated twenty-four (24) to thirty-six (36) inches above the top or covering sod; shall be fitted with a solid watertight cover that overlaps the framed opening and extends down around the frame at least two (2) inches; should be hinged at one (1) side; and shall have a locking device.

8.1.h. Vents. -- Finished water storage structures shall be vented. Overflows shall not be considered as vents. Open construction between the sidewall and roof is not permissible. Vents shall prevent the entrance of surface water and rainwater and shall exclude birds, animals and insects, as much as this function can be made compatible with effective venting. For elevated tanks and standpipes, four (4) mesh non-corrodible screen may be used. On ground-level structures, standpipes shall terminate in an inverted U construction with the opening twenty-four (24) to thirty-six (36) inches above the roof or sod and be covered with twenty-four (24) mesh non-corrodible screen installed within the pipe at a location least susceptible to vandalism.

8.1.i. Roof and sidewall. -- The roof and sidewalls of all structures shall be watertight with no openings except properly constructed vents, manholes, overflows, risers, drains, pump mountings, control ports and piping for inflow and outflow.

8.1.i.1. Any pipes running through the roof or sidewall of a finished water storage structure shall be welded, or properly gasketed in metal tanks. In concrete tanks, these pipes shall be connected to standard wall castings that were poured in place during the forming of the concrete. These wall castings should have seepage rings imbedded in the concrete.

8.1.i.2. Openings in a storage structure roof or top, designed to

accommodate control apparatus or pump columns, shall be curbed and sleeved with proper additional shielding to prevent the access of surface or floor drainage water into the structure.

8.1.i.3. Valves and controls should be located outside the storage structure so that the valve stems and similar projections will not pass through the roof or top of the reservoir.

8.1.i.4. The roof of concrete reservoirs with an earthen cover shall be sloped to facilitate drainage. Consideration should be given to installation of an impermeable membrane roof covering.

8.1.i.5. Locks shall be provided on valve vaults where applicable.

8.1.j. Drainage of roof. -- The roof of the storage structure shall be well drained. Downspout pipes shall not enter or pass through the reservoir. Parapets, or similar construction that would tend to hold water and snow on the roof, will not be approved by the Environmental Engineering Division unless adequate waterproofing and drainage are provided.

8.1.k. Safety. -- The safety of employees shall be considered in the design of the storage structure. As a minimum, employee safety matters shall conform to pertinent laws and regulations.

8.1.k.1. Ladders, ladder guards, balcony railings, and safely located entrance hatches shall be provided where applicable. Elevated tanks with riser pipes more than eight inches in diameter shall have protective bars over the riser openings inside the tank. Railings or handholds shall be provided on elevated tanks where persons transfer from the access tube to the water compartment.

8.1.l. Freezing. -- All finished water storage structures and their appurtenances, especially the riser pipes, overflows, and vents, shall be designed to prevent freezing that will interfere with proper functioning.

8.1.m. Internal catwalk. -- Every catwalk over finished water in a storage structure shall have a solid floor with raised edges so designed that shoe scrapings and dirt will not fall into the water.

8.1.n. 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 should be provided.

8.1.o. Grading. - The area surrounding a ground-level structure shall be graded in a manner that will prevent surface water from standing within fifty (50) feet.

8.1.p. Painting and cathodic protection. -- Proper protection shall be given to metal surfaces by paints or other protective coatings, by cathodic protective devices, or by

both. Paint systems shall be certified to conform to ANSI/NSF Standard 61: Drinking Water System Components - Health Effects. Interior paint shall be properly applied and cured. After curing, the coating shall not transfer any substance to the water that will be toxic or cause tastes or odors. Prior to placing in service, an analysis for volatile organic compounds is advisable to establish that the coating is properly cured. Cathodic protection shall be installed on below grade steel reservoirs and should be designed and installed by competent technical personnel; a maintenance contract should be provided.

8.1.q. Disinfection -- Finished water storage structures shall be disinfected in accordance with current AWWA Standard C652. Three (3) or more successive sets of samples, taken at twenty-four (24) hour intervals, shall be microbiologically satisfactory water before the facility is placed into operation. Disposal of heavily chlorinated water from the tank disinfection process shall be in accordance with the requirements of the WVDEP. The disinfection procedure (AWWA C652 chlorination method 3, section 4.3) that allows use of the chlorinated water held in the storage tank for disinfection purposes is not recommended. When that procedure is used, it is recommended that the initial heavily chlorinated water be properly disposed in order to prevent the release of water that may contain various chlorinated organic compounds into the distribution system.

8.1.r. Provisions of Sampling. -- Appropriate sampling taps shall be provided to facilitate collection of water samples for both bacteriologic and chemical analyses.

8.2. Plant Storage. -- The applicable design standards for finished water storage shall be followed for plant storage.

8.2.a. Washwater tanks. -- Washwater tanks shall be sized, in conjunction with available pump units and finished water storage, to provide the backwash water required. Consideration shall be given to the backwashing of several filters in rapid succession.

8.2.b. Clearwell. -- Clearwell storage should be sized, in conjunction with distribution system storage, to relieve the filters from having to follow fluctuations in water use and meet peak demands, including filter backwash water. When finished water storage is used to provide contact time for chlorine, special attention shall be given to size and baffling. To ensure adequate chlorine contact time in accordance with the West Virginia Division of Health rule, Public Water Systems, 64CSR3, sizing of the clearwell should include extra volume to accommodate depletion of storage during the nighttime for intermittently operated filtration plants with automatic high service pumping from the clearwell during non-treatment hours. An overflow and vent shall be provided.

8.2.c. Adjacent compartments. -- Finished water shall not be stored or conveyed in a compartment adjacent to unsafe water when the two compartments are separated by a single wall.

8.2.d. Basins and wet-wells. -- Receiving basins and pump wet wells for finished water shall be designed as finished water storage structures.

8.3. Hydropneumatic Tanks. -- Hydropneumatic (pressure) tanks, when provided as the only storage facility, are acceptable only in very small water systems. When serving more than 75 living units, ground or elevated storage should be provided. Pressure tank storage is not allowed for fire protection purposes.

8.3.a. Location. -- The tank shall be located above normal ground surface and be completely housed.

8.3.b. Sizing -- The capacity of the wells and pumps in a hydropneumatic system shall be at least ten (10) times the average daily consumption rate. The gross volume of the hydropneumatic tank, in gallons, should be at least ten (10) times the capacity of the largest pump, rated in gallons per minute. For example, a two hundred fifty (250) gallon per minute pump shall have a two thousand five hundred (2,500) gallon pressure tank. Sizing of hydropneumatic storage tanks shall consider the need for chlorine detention time, as applicable, independent of the storage requirements. If hydropneumatic tanks are considered for chlorine contact, separate inlet and outlet connectors at opposite sides of the tank are required.

8.3.c. Piping. -- The hydropneumatic tank shall have bypass piping to permit operation of the system while it is being repaired or painted.

8.3.d. Appurtenances. -- Each hydropneumatic tank shall have an access manhole, a drain and control equipment consisting of pressure gauge, water sight glass, automatic or manual air blow-off, a means for adding air, and pressure operated start-stop controls for the pumps. Where practical the access manhole should be twenty-four (24) inches in diameter.

8.3.e. Coatings. -- Interior of all tanks shall be coated with a hot dipped zinc coating or equivalent meeting ANSI/NSF Standard 61: Drinking Water System Components - Health Effects.

8.4 Distribution Storage. -- The applicable design standards of subsection 8.1 of this rule shall be followed for distribution system storage. Tanks shall provide a minimum of two (2) days' average consumption at one hundred fifty (150) gallons per customer per day plus fire storage as determined by the ISO if applicable. All tanks shall be controlled to provide an adequate turn-over of at least twenty percent (20%) of the total volume each twenty-four (24) hour period. This may require a main line altitude valve or externally controlled valves.

8.4.a. Pressures. -- The maximum variation between high and low levels in storage structures providing pressure to a distribution system should not exceed thirty (30) feet (thirteen (13) pounds per square inch). The minimum pressure in the distribution system shall be thirty (30) pounds per square inch under static conditions and twenty (20) pounds per square inch under all flow conditions. The normal working pressure should be approximately sixty (60) pounds per square inch. When static pressures exceed one hundred (100) pounds per square inch, pressure reducing devices should be provided on mains in the distribution system or at each meter setting.

8.4.b. Drainage. -- Storage structures that provide pressure directly to the distribution system shall be designed so they can be isolated from the distribution system and drained for cleaning or maintenance without necessitating loss of pressure in the distribution system. The drain shall discharge to the ground surface with no direct connection to a sewer or storm drain.

8.4.c. Level controls. -- Commercially available control systems shall be provided to maintain levels in distribution system storage structures. Level indicating devices should be provided at a central location. Pumps should be controlled from tank levels with the signal transmitted by telemetering equipment when any appreciable head loss occurs in the distribution system between the source and the storage structure. Altitude valves or equivalent controls may be required for additional structures on the system. Overflow and low-level warnings or alarms should be located at places in the community where they will be under responsible surveillance twenty-four (24) hours a day.

§64-77-9. Distribution Systems.

9.1. Materials.

9.1.a. Standards and materials selection. -- Pipe, fittings, valves and fire hydrants shall conform to AWWA standards, meet ANSI/NSF Standard 61: Drinking Water System Components - Health Effects and shall be acceptable to the Environmental Engineering Division. In the absence of such standards, materials meeting applicable product standards and acceptable to the Environmental Engineering Division may be selected. Special attention shall be given to selecting pipe materials that will protect against both internal and external pipe corrosion. Pipes and pipe fittings containing more than eight percent (8%) lead shall not be used. All products shall comply with ANSI/NSF Standard 61: Drinking Water System Components - Health Effects.

9.1.b. Permeation of system by organic compounds.-- Where distribution systems are installed in areas of groundwater contaminated by organic compounds: pipe and joint materials that are not subject to permeation of the organic compounds shall be used; and non-permeable materials shall be used for all portions of the system including water main, service connections and hydrant leads.

9.1.c. Used materials. -- Water mains that have been used previously for conveying potable water may be reused provided they meet the above standards and have been restored practically to their original condition.

9.1.d. Joints. -- Packing and jointing materials used in the joints of pipe shall meet the standards of the AWWA, ANSI/NSF Standard 61 and the Environmental Engineering Division. Pipe having mechanical joints or slip-on joints with rubber gaskets is preferred. Lead-tip gaskets shall not be used. Repairs to lead-joint pipe shall be made using alternative methods.

9.2. Water Main Design.

9.2.a. All distribution systems shall be designed to provide a residential peak demand flow (not including fire flows) in accordance with Table 64-77 E.

9.2.b. Pressure. -- All water mains, including those not designed to provide fire protection, shall be sized after a hydraulic analysis based on peak flow demands and pressure requirements. The system shall be designed to maintain a minimum pressure of twenty (20) pounds per square inch at ground level at all points in the distribution system under all conditions of flow and thirty (30) pounds per square inch under static conditions. The normal working pressure in the distribution system should be approximately sixty (60) pounds per square inch. Water main operating pressures should be in accordance with the standards of the manufacturer and the American Water Works Association.

9.2.c. Surge Pressures. -- All water mains shall be designed to provide adequate strength to withstand water surge pressure. Table 64-77 F lists the minimum

acceptable pressure surge for PVC for each foot per second velocity of water. Design shall allow for at least 5 feet per second instantaneous flow velocity change or higher if conditions warrant.

9.2.d. Diameter. -- The minimum size of a water main for providing fire protection and serving fire hydrants shall be of six (6) inch diameter. Larger size mains will be required if necessary to allow the withdrawal of the required fire flow while maintaining the minimum residual pressures.

9.2.e. Fire protection. -- When fire protection is to be provided, system design should be such that fire flows and facilities are in accordance with the requirements of the ISO. Under no circumstances shall fire flows be less than two hundred fifty (250) gallons per minute.

9.2.f. Small mains. -- Any departure from minimum six (6) inch diameter requirements shall be justified by hydraulic analysis and future water use, and can be considered only in special circumstances; however, no mains less than two (2) inches are permitted.

9.2.g. Hydrants. -- Water mains not designed to carry fire-flows shall not have fire hydrants connected to them.

9.2.h. Dead ends -- In order to provide increased reliability of service and reduce head loss, dead ends shall be minimized by making appropriate tie-ins whenever practical. Where dead-end mains occur, they shall be provided with a fire hydrant if flow and pressure are sufficient, or with a flushing hydrant or blow-off, approved by the Environmental Engineering Division, for flushing purposes. Flushing devices should be sized to provide flows that will give a velocity of at least 2.5 feet per second in the water main being flushed. No flushing devices shall be directly connected to any sewer.

9.3. Valves. -- A sufficient number of valves shall be provided on water mains so that inconvenience and sanitary hazards will be minimized during repairs. Valves should be located at not more than five hundred (500) foot intervals in commercial districts and at not more than one block or eight hundred (800) foot intervals in other districts. Where systems serve widely scattered customers and where future development is not expected, the valve spacing should not exceed two thousand five hundred (2,500) feet.

9.4. Hydrants.

9.4.a. Location and spacing. -- Hydrants should be provided at each street intersection and at intermediate points between intersections as recommended by the ISO. Generally, hydrant spacing may range from three hundred fifty (350) to one thousand (1000) feet depending on the area being served.

9.4.b. Valves and nozzles. -- Fire hydrants should have a bottom valve size of at least five (5) inches, one 4-1/2 inch pumper nozzle and two 2-1/2 inch nozzles.

9.4.c. Hydrant leads. -- The hydrant lead shall be a minimum of six (6) inches in diameter. Auxiliary valves shall be installed in all hydrant leads.

9.4.d. Drainage. -- Hydrant drains are to be provided with a gravel pocket, or a dry well shall be provided unless the natural soils will provide adequate drainage. Hydrant drains shall not be connected to or located within ten (10) feet of sanitary sewers or storm drains.

9.4.e. Draining type frost proof yard hydrants shall not be permitted.

9.5 Air Relief Valves, Valve, Meter and Blow-off Chambers.

9.5.a. Air relief valves. -- At high points in water mains where air can accumulate, provisions shall be made to remove the air by means of hydrants or air relief valves. Automatic air relief valves shall not be used in situations where flooding of the manhole or chamber may occur.

9.5.b. Air relief valve piping. -- The open end of an air relief pipe from automatic valves shall be provided with a screened, downward-facing elbow. The pipe from a manually operated valve should be extended to the top of the pit. Use of manual air relief valves is recommended wherever possible.

9.5.c. Chamber drainage. -- Chambers, pits or 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 blow-offs or air relief valves be connected directly to any sewer. Such chambers or pits shall be drained to the surface of the ground where they are not subject to flooding by surface water or to absorption pits underground.

9.6. Installation of Mains

9.6.a. Standards. -- Specifications shall incorporate the provisions of the AWWA standards and manufacturer's recommended installation procedures.

9.6.b. Bedding. -- A continuous and uniform bedding shall be provided in the trench for all buried pipe. Backfill material shall be tamped in layers around the pipe and to a sufficient height above the pipe to adequately support and protect the pipe. Stones found in the trench shall be removed for a depth of at least six (6) inches below the bottom of the pipe.

9.6.c. Cover -- All water mains shall be covered with sufficient earth or other insulation to prevent freezing. All distribution mains shall be provided with a minimum of thirty-six (36) inches of earth covering; forty-two (42) inches are recommended. All mains of less than eight (8) inches in diameter within five (5) feet of a heavily traveled highway shall be provided with at least forty-two (42) inches of cover.

9.6.d. Blocking. -- All tees, bends, plugs and hydrants shall be provided with thrust blocking, tie rods or joints designed to prevent movement.

9.6.e. Pressure and leakage testing. -- All types of installed pipe shall be pressure tested and leakage tested in accordance with AWWA Standard C600.

9.6.f. Disinfection. -- All new, cleaned or repaired water mains shall be disinfected in accordance with AWWA Standard C651. The specifications shall include microbiological testing of all water mains. Microbiological sampling shall be collected by a Environmental Engineering Division certified public water system operator or other individual authorized by the Environmental Engineering Division.

9.6.g. All non-metallic mains shall be provided with tracer wire or metallic tape.

9.7. Separation of Water Mains, Sanitary Sewers and Storm Sewers.

9.7.a. General. -- The following factors should be considered in providing adequate separation: 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 and off-setting of pipes around manholes.

9.7.b. Parallel installation. -- Water mains shall be laid at least 10 feet horizontally from any existing or proposed sewer. The distance shall be measured edge to edge.

9.7.c. Crossings. -- Water mains shall cross above sewers and shall be laid to provide a minimum vertical distance of 18 inches between the bottom of the water main and the top of the sewer. At crossings, one full length (20 feet) of water pipe shall be located so both joints will be as far from the sewer as possible. Special structural support for the water and sewer pipes may be required.

9.7.d. Force mains. -- There shall be at least a ten (10) foot horizontal separation between water mains and sanitary sewer force mains. There shall be an eighteen (18) inch vertical separation at crossings as required.

9.7.e. Exception. -- The Environmental Engineering Division may approve a variance from the above requirements when it determines that compliance with the specified separation distances cannot be practically achieved.

9.7.f. Sewer manholes. -- No water pipe shall pass through or come in contact with any part of a sewer manhole.

9.7.g. Separation of water mains from other sources of contamination. -- Design engineers should exercise caution when locating water mains at or near certain sites such as sewage treatment plants or industrial complexes. Individual septic tanks shall be located and

avoided. The engineer shall contact the Environmental Engineering Division to establish specific design requirements for locating water mains near any source of contamination.

9.8. Surface Water Crossings. -- The Environmental Engineering Division should be consulted before final plans are prepared.

9.8.a. Above-water crossings. -- An above-water crossing pipe shall be adequately supported and anchored, be protected from damage and freezing and be accessible for repair or replacement.

9.8.b. Underwater crossings. -- A minimum cover of three (3) feet shall be provided over the pipe where practical. When crossing water courses that are greater than fifteen (15) feet in width, the following shall be provided: the pipe shall be ductile iron of special construction, having flexible watertight joints; 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 permanent taps shall be made on each side of the valve to allow insertion of a small meter to determine leakage and for sampling purposes.

9.9. Cross-connections and Interconnections.

9.9.a. Cross-connections. -- There shall be no connection between the distribution system and any pipes, pumps, hydrants, or tanks whereby unsafe water or other contaminating materials may be discharged or drawn into the system. Each water utility shall have a program conforming to state requirements to detect and eliminate cross connections.

9.9.b. Cooling water. -- Neither steam condensate nor cooling water from engine jackets or other heat exchange devices shall be returned to the potable water supply.

9.9.c. Interconnections. -- The approval of the Environmental Engineering Division shall be obtained for interconnections between approved public water systems.

9.10. Water Services and Plumbing.

9.10.a. Plumbing. -- Water services and plumbing shall conform to relevant local and state plumbing codes or to the applicable National Plumbing Code. Solders and flux containing more than 0.2% lead and pipe and pipe fittings containing more than eight percent (8%) lead shall not be used. The public water system is not responsible for an individual customer's private plumbing.

9.10.b. Booster pumps. -- Individual booster pumps are not allowed for any individual service from the public water supply mains where residual pressures are less than five (5) pounds per square inch under all flow conditions. Where used, backflow prevention, approved by the Environmental Engineering Division, consisting of at least a double check valve assembly shall be provided by the customer to protect the public water supply.

9.11. Service Meters -- Each service connection should be individually metered.

9.12. Water Loading Stations. -- Water loading stations present special problems since the fill line may be used for filling both potable water vessels and other tanks or contaminated vessels. To prevent contamination of both the public supply and potable water vessels being filled, the following principles shall be met in the design of water loading stations: there shall be a double check valve assembly approved by the Environmental Engineering Division and installed to prevent backflow to the public water supply; the piping arrangement shall prevent contaminant being transferred from a hauling vessel to another. Hoses shall not be contaminated by contact with the ground and shall be capped when not in use. Water meters should be provided.

§64-77-10. Enforcement Penalties.

10.1. Violators of this rule are subject to the civil and administrative penalties of W. Va. Code §§16-1-9a(d)(2) and (3) and the criminal penalties of W. Va. Code §§16-1-9, -9a(d)(1) and -18.

§64-77-11. Administrative Due Process.

11.1. Those persons aggrieved by the administrative enforcement of this rule may request a contested case hearing in accordance with the Division of Health rule, "Rules and Procedures for Contested Case Hearings and Declaratory Rulings," 64CSR1.

TABLE 64-77 A

	Water Lines
Raw	Olive Green
Settled or Clarified	Aqua
Finished or Potable	Dark Blue
	Chemical Lines
Alum or Primary Coagulant	Orange
Ammonia	White
Carbon Slurry	Black
Caustic	Yellow with Green Band
Chlorine (Gas or Solution)	Yellow
Fluoride	Light Blue with Red Band
Lime Slurry	Light Green
Ozone	Yellow with Orange Band
Phosphate Compounds	Light Green with Red Band
Polymers or Coagulant Aids	Orange with Green Band
Potassium Permanganate	Violet
Soda Ash	Light Green with Orange Band
Sulfuric Acid	Yellow with Red Band
Sulfur Dioxide	Light Green with Yellow Band
	Waste Lines
Backwash Waste	Light Brown
Sludge	Dark Brown
Sewer (Sanitary or Other)	Dark Gray
	Other
Compressed Air	Dark Green
Gas	Red
Other Lines	Light Gray

TABLE 64-77 B

Source	Minimum Distance
Sewage Treatment Facilities	200 ft.
Sewers and Drains	50 ft.
Sewage Holding Tanks and Privies(Vault)	200 ft.
Barnyard/Feeding and Watering Areas	200 ft.
Streams, Rivers and Impoundments	25 ft.[1]

[1]Where possible, the well casing shall extend above the one hundred (100) year flood level. When this level is not known, the flood level shall be that level that is six (6) feet above the normal water level of the surface.

TABLE 64-77 C

Size	Depth
2 ½ to 1 ½ inches	5 to 8 inches
1 ½ 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

TABLE 64-77 D

STEEL PIPE					
SIZE	DIAMETER (inches)		THICKNESS (inches)	WEIGHT PER FOOT (pounds)	
	EXTERNAL	INTERNAL		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	
18	18.000	17.250	0.375	70.59	
20	20.000	19.250	0.375	78.60	
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	

TABLE 64-77 E

No. of Homes	Peak Design Flow gpm	No. of Homes	Peak Design Flow gpm
1	14	50	70
2	18	60	76
3	20	70	82
4	22	80	88
6	25	90	94
8	28	100	100
10	30	125	110
15	37	150	120
20	43	175	132
25	48	200	140
30	53	300	175
40	62	400	200

More than 400 homes, use 0.5 gallons per minute per home.

Note: Commercial, industrial, or other high-user customers are not covered in this table and shall be included in the design of the distribution system.

TABLE 64-77 F

DESIGN TABLE FOR PVC PIPE
PRESSURE SURGE vs. DIMENSION RATIO

[In response to 1 foot per second instantaneous flow velocity change]

Dimension Ratio	Pressure Surge, psi (kPa)
13.5	20.2 (139)
14	19.8 (139)
17	17.9 (123)
18	17.4 (120)
21	16.0 (110)
25	14.7 (101)
26	14.4 (99)
32.5	12.8 (88)
41	11.4 (79)

Figure 64-77 G

Requirements for Grouting Through Voids

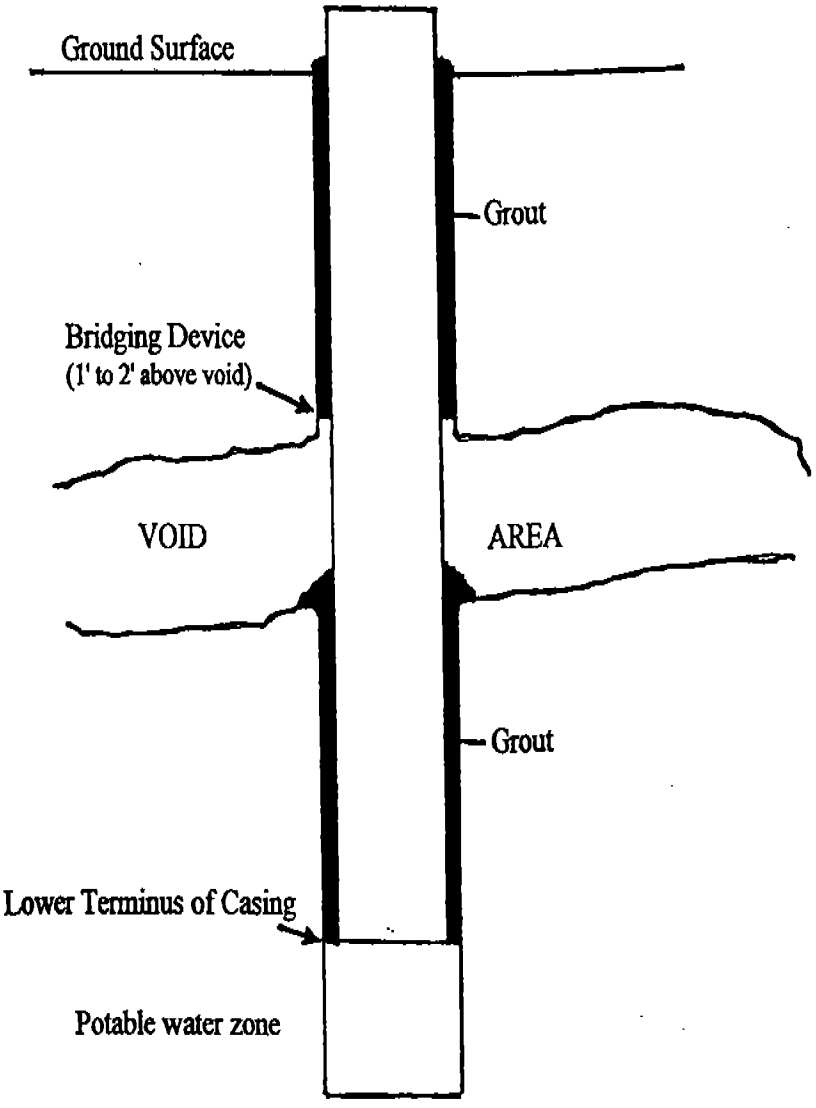

Figure 64-77 H

Requirements for Grouting Unconsolidated Water Table Wells

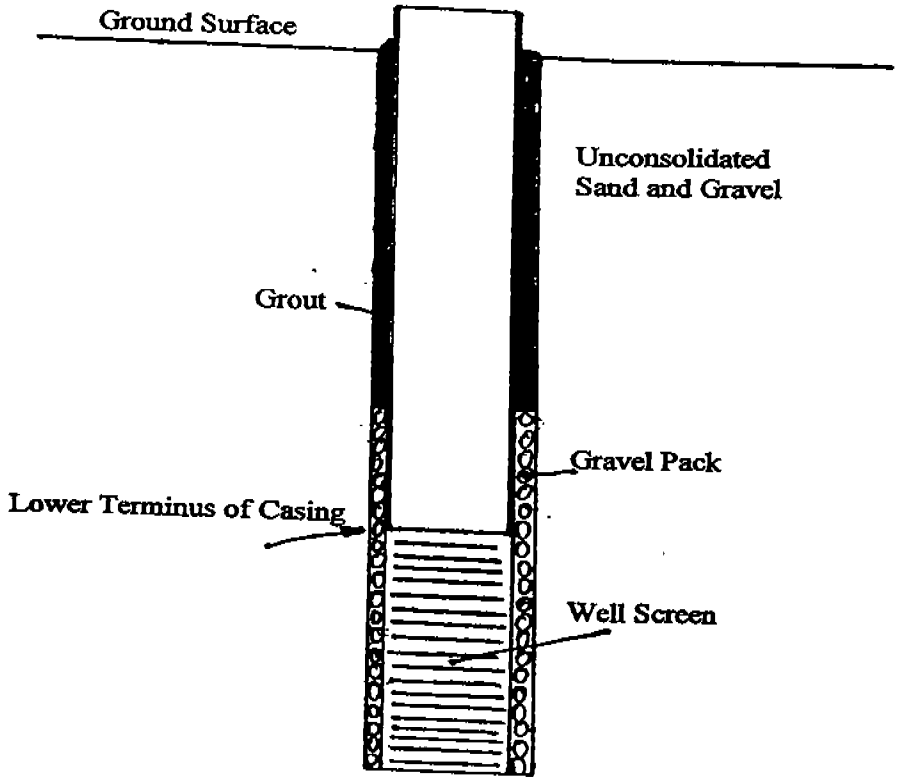

Figure 64-77 I

Requirements for Grouting Wells with Pitless Adapters