MINIMUM STANDARDS

FOR

PUBLIC WATER SYSTEMS

May, 2000

Drinking Water Permitting & Engineering Program
Georgia Environmental Protection Division
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Revision: 05172000.OES.2.0.2nd Edition

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FOREWORD

This publication has been prepared to provide minimum design criteria and establish certain standards in the development and construction of public water supply systems. This document would help water system owners, operators, professional engineers, and the public in general understand about the standards used in the design and construction of public water supply systems. We consider these standards to be dynamic and subject to periodic updates and revisions, as necessary, to conform with the latest drinking water regulations. If you are planning to develop a new public water supply system, or make additions, extensions, repairs, improvements or modifications to an existing public water system, please make sure that you are using the latest edition of the "Minimum Standards for Public Water Systems".

There has been no attempt to include or address every situation in this publication. Certainly, there may be occasions when these standards may not apply or cover. In those circumstances, the design of the facilities should meet the needs of the particular situation. Nothing in these minimum standards should be construed as preventing the professional engineer from recommending or the Georgia Environmental Protection Division from approving more effective treatment where local conditions dictate such action. You must contact the Drinking Water Permitting and Engineering Program of the Division for clarification and guidance prior to any construction. Any exceptions will be handled on an individual basis. However, it must be understood that development and operation of all public water systems are required, by law, to comply with the Georgia Rules for Safe Drinking Water, Chapter 391-3-5, promulgated under the Georgia Safe Drinking Water Act.

Should at any time an experimental installation, made based on engineering data, fail to produce results satisfactory to the Division, then immediate steps must be taken to replace it by a conventional installation approved by the Division.

The term “Division” as used herein refers to the Georgia Environmental Protection Division, Drinking Water Permitting and Engineering Program. Other terms, such as “shall” and “must” are intended to mean mandatory procedures. The terms “should,” “recommended,” and “preferred,” indicate desirable procedures or methods.

The Recommended Standards for Water Works, 1992 Edition, "Great Lakes Upper Mississippi River Board of State Public Health & Environmental Managers", commonly known as the "Ten-State Standards” were used as a guide in the preparation of Georgia’s Minimum Standards for Public Water Systems.

ACKNOWLEDGEMENTS and REFERENCES

We have reviewed standards from various state drinking water agencies along with a number of other nationally accepted standards for inclusion in the development of this document. Therefore, these standards are a compilation of information from the current Georgia Rules for Safe Drinking Water, Chapter 391-3-5, and a number of other acceptable sources as listed below:

1. Georgia Rules for Safe Drinking Water, Chapter 391-3-5, October 16, 1997.

2. Recommended Standards for Water Works, 1992 Edition, "Great Lakes Upper Mississippi River Board of State Public Health & Environmental Managers", commonly known as "Ten-State Standards".

3. American Water Works Association (AWWA) Standards, 1992 Edition.

4. "Guidance Manual for Compliance With the Filtration and Disinfection Requirements for Public Water Systems using Surface Water Sources", U.S.E.P.A., October, 1990.

5. "Manual of Small Public Water Supply Systems", U.S.E.P.A., Office of Water, May, 1991.

6. "Small System Compliance Technology List for the Surface Water Treatment Rule", U.S.E.P.A., Office of Water, August, 1997.

7. Small Water Systems Serving the Public – Manual (correlated with National Drinking Water Regulations), Conference of State Sanitary Engineers in cooperation with Office of Drinking Water, U.S.E.P.A., July, 1978.

8. Tennessee Department of Environment and Conservation, "Community Public Water Systems Design Criteria", 1997.

9. North Carolina Department of Environment, Health, and Natural Resources, "Rules Governing Public Water Systems", Subchapter 18C-Water Supplies, August 1, 1996.

10. "Design Standards for Public Water Supply Systems", Environmental Health Services, Division of Sanitary Engineering, West Virginia State Department of Health, January 1, 1970.

11. "Georgia's Requirement for Business Plans", Georgia Department of Natural Resources, Environmental Protection Division, Memorandum, Edward Urheim, Drinking Water Permitting and Engineering Program, July 23, 1999.

12. Iowa Department of Natural Resources, Water Supply Section, "Self-Assessment Manual for Iowa Water System Viability", December 1, 1997.

13. "Guidance on Implementing the Capacity Development Provisions of the Safe Drinking Water Act Amendments of 1996", U.S.E.P.A., Office of Water, July 1998.

14. Pennsylvania Department of Environmental Protection, Bureau of Water Supply Management, "Public Water Supply Manual, Part V-Section I and II - Operations and Maintenance (ID No. 383-3110-111)", November 1, 1997.

15. Pennsylvania Department of Environmental Protection, Bureau of Water Supply Management, "Public Water Supply Manual, Part V (Appendix A) Operations and Maintenance for Small Groundwater Systems (ID No. 383-3110-211)", May 1, 1999.

APPROVAL REQUIREMENTS FOR PUBLIC WATER SYSTEMS

The following is Section 391-3-5-.04 of the Georgia Rules for Safe Drinking Water, which outlines the "Approval Requirements" for public water supply systems in Georgia.

(1) No person shall erect, construct, or operate a public water system, nor undertake substantial enlargements, extensions, additions, modifications, renovations or repairs to any public water system, including storage, distribution, purification, or treatment components, without having first secured the Division's approval of: the source of water supply; the means and methods of treating, purifying, storing and distributing said water; and obtaining a permit to operate a public water system, except as provided by paragraph (2) of this Section. The approval of the Director must be obtained prior to the dividing of a public water system. For purposes of these rules "substantial" as used in this Section shall not include routine maintenance.

(2) Governmentally owned public water systems and water authorities with qualified staff and meeting operating criteria developed by the Division may, with prior approval from the Division, approve limited additions to the water system. These additions will be limited to water distribution lines to serve subdivisions, apartment complexes and shopping centers. Additions approved by the water system must be reported annually in a format prescribed by the Division.

(3) Before a person may initiate construction of a new public water system or increase the capacity of an existing public water system, the person shall notify the local government in which the system is located and obtain the local government's approval for development of the project within its jurisdiction, prior to the submittal of the plans and specifications to the Division for approval. To the extent practicable, the person should avoid locating part or all of the new or expanded facility at a site which:

(a) is subject to a significant risk from earthquakes, floods, fires or other disasters which could cause a breakdown of the public water system or a portion thereof; or

(b) except for intake structures, is within the floodplain of a 100-year flood or is lower than any recorded high tide where appropriate records exist; or

(c) is on or in close proximity to an abandoned landfill or any other site used for waste disposal.

(4) The requirements of this paragraph shall apply to all non-governmentally owned community public water systems that have been issued a permit to operate by the Director or have applied for a permit before January 1, 1998. To assure the continuity of operation and maintenance of a non-governmentally owned and operated public water system when the water customers own the property being served by the supplier, the supplier of the water system shall file with the Division an executed Trust Indenture as prescribed by the Division and approved by the Director. The Trustee should preferably be a governmental authority. When a governmental authority is not available, the Trustee should be a property owners association organized to guarantee the operation and maintenance of the public water system. The association must be

made up of members who are owners of properties served by the water system. The Articles of Incorporation and By-Laws of the association are to be submitted to the Division for review and/or approval. If a Trustee other than a unit of local government or property owners association is proposed, it will be necessary to determine that there is no identity-of-interest between the owner of the system and the Trustee. For new or proposed systems, the legal documents shall be submitted with the plans and specifications. When the supplier is or desires to serve water to property not individually owned by the water customer, a legal document assuring the continuity and maintenance of operation may not be required.

(5) Any person who desires to own or operate or who desires to commence the operation of a public water system shall first evaluate connecting to an existing local governmentally owned and operated public water system.

(6) No approval of the plans and specifications for the development of a separate source of water supply or the construction of the water system will be made and no permit to operate will be issued until the owner has provided acceptable certification to the Division outlining the reasons why the system cannot connect to an existing local governmentally owned water system.

(7) Beginning January 1, 1998, the Division shall require compliance with the following conditions prior to the issuance of the initial permit to operate to a new privately owned community public water system:

(a) The owner shall provide written certification from the local government in which the system is located, that the local government is in concurrence with the development of the privately owned community public water system. The certification shall be provided to the Division with the submission of the permit application and prior to or concurrently with the submission to the Division of the plans and specifications for construction of the proposed public water system.

(b) The owner must retain a Professional Engineer, registered in the State of Georgia, to prepare plans and specifications for approval by the Division for the construction of the proposed public water system, and the owner shall submit to the Division a certification from the engineer that the water system was constructed according to the plans and specifications approved by the Division. The public water system must be designed and constructed in accordance with the Division's "Minimum Standards for Public Water Systems", latest edition.

(c) The owner must submit to the Division for approval, a multi-year "business plan" (see Appendix A) which adequately demonstrates the water system's managerial and financial capacity to comply with all drinking water regulations in effect, or likely to be in effect. The "business plan" shall be prepared in accordance with Appendix A of this publication. The "business plan" shall be updated at intervals determined by the Director.

(d) The owner must provide an approved back-up water source, such as an additional well, capable of providing adequate water service if the primary source becomes nonfunctional. The requirement for an approved back-up water source may be waived by the Director for systems with less than 25 service connections.

(e) The owner must submit a copy of a trust indenture or other legal agreement approved by the Division that has been executed with the local government in which the system is located, which assures the operation and maintenance of the public water system in compliance with the drinking water regulations established pursuant to the Act. For acting as the Trustee of the water system, the local government may at its discretion require the owner to provide a trust fund, performance bond, or irrevocable letter of credit. No later than one year after the public water system commences operation and at least every two years thereafter, the owner must submit to the Division and the Trustee the results of an evaluation, by a third party acceptable to the Division, of the water system's financial, technical, and operational capability to meet the current and future needs of the water system's customers and the drinking water regulations established pursuant to the Act. Upon written notification by the Division to the owner of violations of the regulations established pursuant to the Act and/or deficiencies in the financial, technical and/or operational status of the water system, the owner shall have a reasonable period of time to correct all said violations and deficiencies to the Division's satisfaction. Should the owner fail after a reasonable period of time after receiving written notice to correct violations of the drinking water regulations established pursuant to the Act and/or deficiencies in the financial, technical and/or operational capability of the system, the Trustee under the conditions of the trust indenture may use funds from the trust fund, performance bond or irrevocable letter of credit to obtain compliance with the said regulations and/or correct said deficiencies. In addition, if the water system owner fails after a reasonable period of time to correct all said violations and deficiencies, under the conditions of the trust indenture the Trustee may assume ownership of the public water system in order to assure that the water system is properly maintained and operated for the benefit of the system's customers. For new or proposed community water systems, the legal documents shall be submitted with the plans and specifications.

(f) If the local government is not available or agreeable to be the Trustee for a proposed privately owned community public water system, written documentation from the local government certifying it has no desire to act in this capacity shall be provided to the Division. When the local government is not available or agreeable to be the Trustee, the owner shall obtain a Trustee acceptable to the Division and execute a trust indenture or other legal agreement approved by the Division. If a Trustee other than a local government or a property owners association is proposed, it will be necessary for the owner and the Trustee to certify in writing to the Division that there is no identity-of-interest between the owner of the system and the Trustee. For acting as the Trustee of the water system, the Trustee may at its discretion require the owner to provide a trust fund, performance bond, or irrevocable letter of credit. No later than one year after the public water system commences operation and at least every two years thereafter, the owner must submit to the Division and the Trustee the results of an evaluation, by a third party acceptable to the Division, of the water system's financial, technical, and operational capability to meet the current and future needs of the water system's customers and the drinking water regulations established pursuant to the Act. Upon written notification by the Division to the owner of violations of the regulations established pursuant to the Act and/or deficiencies in the financial, technical and/or operational status of the water system, the owner shall have a reasonable period of time to correct all said violations and deficiencies to the Division's satisfaction. Should the owner fail after a reasonable period of time after receiving written notice to correct violations of the drinking water regulations established pursuant to the Act and/or deficiencies in the financial, technical and/or operational capability of the system, the Trustee under the conditions of the trust indenture may use funds from the trust fund, performance bond or irrevocable letter of credit to obtain compliance with the said regulations and/or correct said deficiencies. In addition, if the water system owner fails after a reasonable period of time to correct all said violations and deficiencies, under the conditions of the trust indenture the Trustee may assume ownership of the public water system in order to assure that the water system is properly maintained and operated for the benefit of the system's customers. For new or proposed community water systems, the legal documents shall be submitted with the plans and specifications.

(8) Products added directly to drinking water for its treatment or introduced indirectly into drinking water through its contact with surfaces of materials or products used for its treatment, storage, transmission, or distribution shall not adversely affect drinking water quality and public health.

(a) All treatment chemicals that come into contact with drinking water shall be certified for conformance with American National Standards Institute/National Sanitation Foundation Standard 60 (ANSI/NSF Standard 60) by an American National Standards Institute (ANSI) approved third-party certification program or laboratory.

(b) All products that come into contact with drinking water during its treatment, storage, transmission or distribution shall be certified for conformance with American National Standards Institute/National Sanitation Foundation Standard 61 (ANSI/NSF Standard 61) by an American National Standards Institute (ANSI) approved third-party certification program or laboratory.

PART 1 - SUBMISSION OF ENGINEERING DOCUMENTS

1.1.1 GENERAL - For any activity listed in Section 391-3-5-.04 of the Rules for Safe Drinking Water (see Introduction section in the previous pages), an engineering report prepared by a professional engineer shall be submitted to the Division prior to the preparation of the final construction plans and specifications. Plans and specifications shall be prepared by a professional engineer, licensed in the state of Georgia, and submitted to the Division in duplicate, accompanied by a letter of submittal identifying the project, owner and owner's address. No construction shall be initiated without prior approval from the Division.

The documents submitted for the Division's review and approval shall include:

a. A summary of the basis of design; hydraulic calculations and profiles;

b. Operation requirements, where applicable;

c. General layout;

d. Detailed plans;

e. Detailed material and construction specifications;

f. Description and drawing for erosion and sedimentation control in accordance with the Georgia Erosion and Sedimentation Act, as amended, and local soil and sedimentation control ordinances (when applicable). Land Disturbance permits must be obtained from the appropriate authority prior to commencing the land disturbance activity; and,

g. Operating permit application and/or water withdrawal application and/or business plan and/or other pertinent documentation from the local government, as may be necessary or required by the Rules for Safe Drinking Water, Chapter 391-3-5.

1.1.2 PRIVATELY OWNED WATER SYSTEMS: Those projects that are proposing to develop new privately owned community public water systems shall also include the following additional documents in their submittals for the Division's review and approval:

a. A written certification by the owner, supported by proper documentation, outlining the reasons why the proposed system cannot connect to an existing local governmentally owned water system;

b. A written certification from the local government concurring with the development of the privately owned community public water system within its jurisdiction;

c. A "business plan" which adequately demonstrates the water system's managerial and financial capacity to comply with all drinking water regulations in effect, or likely to be in effect. The "business plan" shall be prepared in accordance with Appendix A of this book and shall be updated at intervals determined by the Director.

d. A recorded copy of an executed trust indenture or other legal agreement approved by the Division that has been executed with the local government in which the system is located. In the event the local government is not available, another trustee (acceptable to Division) can be used to assure the operation and maintenance of the system in conformance with the drinking water regulations.

1.1.3 EXCEPTION - The engineering report and/or plans and specifications may be waived by the Director when information submitted by the supplier of water allows an engineering appraisal of the proposed activity to be made by the Division as follows:

a. For minor extensions, additions and/or modification to an existing governmentally owned public water system which does not effect the normal operation of said water system.

b. For new public water systems which are classified as transient non-community water systems (TNCWS) and for additions to existing transient non-community water systems (TNCWS).

1.2.0 ENGINEERING REPORT - The engineering report shall contain a comprehensive description of the proposed activity including, but not limited to, the following:

a. Scope and description of proposed activity,

b. A summary of the alternative solutions, if applicable,

c. Recommendations,

d. Where pertinent, the following information should be included in the engineering report:

1. General description of the existing water system service areas;

2. Description of the proposed source of water supply, and data concerning the quality of the water, as well as water consumption data;

3. Pertinent information regarding present available sources of water supply, water treatment facilities, and existing public water systems;

4. Sufficient maps, diagrams, charts, tables, calculations, basis of design data and graphs to make the report readily understandable; all sheets shall be descriptively labeled and bound together or folded in a folder attached to the report;

5. Operational and maintenance program description;

6. The known character and depth of the natural earth formations through and from which ground water sources are to be developed;

7. Factors which may effect the quality of a source of water supply as determined by a survey of the water shed above the surface water intake or the surrounding area of a ground water source;

8. A multi-year "business plan" (see Appendix A) to adequately demonstrate that the system has the financial, technical, and managerial capability to comply with all the federal and state drinking water regulations in effect, or likely to be in effect and to maintain compliance with the regulations after completion of the proposed activity.

1.2.1 PLANS and SPECIFICATIONS - Plans and specifications must be submitted in duplicate (with additional copies as may be requested) to the Division for its review and approval prior to the construction of the project. These plans and specifications must carry the stamp of a registered engineer or other registered professional licensed and authorized in the State of Georgia and duly qualified and capable of designing water systems and computing flows and pressures in the proposed water system projects. The plans and specifications shall include, but not be limited to the following:

a. Map plans of the area to be served by the public water system, including, but not limited to: geographical location of the project, location of all existing and proposed streets in the area to be served, location of the source of water supply and the treatment facilities, and elevations of the principal parts of the public water system;

b. Detailed plans of the location and the construction of the storage tank, water mains, valves, fire hydrants and appurtenances;

c. Detailed plans of: the location and construction of the water treatment facilities including layout and relationship of the various units of the treatment facility; general piping, pumps, reservoirs, flow measuring devices, controls, points of chemical application, water sampling points, plant control laboratory, chemical feed equipment and chemical storage area. Sufficient dimensions and elevations shall be provided to make all parts of the plans readily understandable;

d. The dimensions of the plan sheets must be within the following limits: twenty (20) to thirty (30) inches in height and twenty-four (24) to forty-two (42) inches in length, and shall be of sufficient clarity to be microfilmed;

e. Each plan sheet shall have printed thereon the name and location of the public water system, name and registration stamp of the professional engineer, scale, true and magnetic north, and shall be bound together and numbered consecutively;

f. If the plans are solely for extensions to an existing public water system, only such information as is necessary for comprehension of the plans and construction of the project will be required;

g. Specifications will be separate from the plans and shall have printed thereon the name and location of the public water system, name and stamp of the professional engineer, and shall be bound together and numbered consecutively;

h. Specifications for the construction of the public water system shall accompany all plans for new or existing public water systems and shall describe the plans for the whole and for each unit or component of construction of the proposed public water system, including where necessary, testing and disinfection, painting, laboratory equipment, metering and recording devices and related material;

i. The specifications may be omitted for extensions or additions to existing systems provided the proposed construction is in accordance with specifications previously approved and on file with the Division;

j. Manufacturers' brochures of specifications of materials are not acceptable for purposes of this requirement.

1.2.2 CHANGES IN PLANS and SPECIFICATIONS AFTER APPROVAL - Any significant deviation from the approved plans or specifications affecting capacity, hydraulic conditions, operating units, the functioning of water treatment processes, the quality of water to be delivered, or any provisions stipulated in the Division's original and subsequent letters of approval must receive prior approval by the Division before any construction or installation.

1.2.3 ENGINEER'S CERTIFICATION - Upon completion of the construction or modification, the water supplier shall submit a statement from the registered professional engineer and affixed with his professional engineering seal stating that construction was completed in accordance with the approved plans and specifications. The statement shall be based upon observations during and upon completion of construction by the engineer or a representative of the engineer's office who is under the engineer's supervision.

PART 2 - PROCEDURES FOR DEVELOPING PRIVATELY OWNED COMMUNITY PUBLIC WATER SYSTEMS THAT ARE USING GROUND WATER (WELLS, SPRINGS) AS SOURCES OF WATER SUPPLY

2.1.0 GENERAL: Any person who desires to own or operate or who desires to commence the operation of a public water system must first evaluate connecting to an existing local governmentally owned and operated public water system, provided:

a. the existing public water system is within close proximity (approximately one mile or less) of the proposed water system is; and,

b. the existing public water system is capable of furnishing the drinking water under adequate water pressure and flow.

c. When, if a governmentally owned and operated public water supply system is not available, then the items listed below under Phases I, II, III and IV must be satisfied.

2.1.1 PHASE I - INQUIRY & DISCOVERY SUBMITTALS:

a. a map showing the geographical location of the proposed project, as well as the location of the governmentally owned and operated public water system closest to the project site;

b. documentation outlining the reasons why the proposed project cannot connect to an existing local governmentally owned water system. A written letter from the nearest governmentally owned City or County water system, denying the owner's request for water service must be attached;

c. written certification from the local government concurring with the development of the privately owned community public water system within its jurisdiction;

d. when applicable, a written concurrence by the nearest governmentally owned water supply system to provide water to the proposed project. The party that will own, operate and maintain the water distribution lines must be clearly stated;

e. a letter, written by the local county government, certifying that the proposed water system development project and the appurtenances pertaining to the water system, are not located on or in close proximity to an abandoned landfill or any other site used for waste disposal;

f. a detailed description of the proposed development project, including the type (residential, mobile home, school, etc.) and the total number of service connections proposed for development, and the type, number and projected capacity of water supply source(s), water use estimates, and the proposed means for the disposal of wastewater generated by the project (individual septic tank system or central wastewater system).

NOTE: If all of the requested information (identified under "Phase I") not received within 90 days from the date of correspondence from the Division, no further consideration will be given for the proposed water system development project. For reconsideration, a separate inquiry must be made to the Drinking Water Permitting and Engineering Program.

2.1.2 PHASE II - TECHNICAL REVIEW SUBMITTALS

a. All engineering documents must be prepared as specified in this document by a professional engineer licensed to practice in the state of Georgia. Please refer to Part 1, titled "Submission of Engineering Documents" in this publication and the Georgia Rules for Safe Drinking Water, Chapter 391-3-5.

b. Additional "special" requirements may apply to those systems that are proposed for construction in the coastal region of Georgia. For those specific requirements, please contact the Environmental Protection Division.

c. The following shall be submitted, as applicable:

1. detailed plans and specifications for the construction of the water system, including material and construction methods for the water source installation, pump house, pumping equipment, electrical controls, storage tanks, paint coating system, water treatment equipment, distribution lines, service connections, valves, disinfection and other related information;

2. a "business plan" (see Appendix A) which adequately demonstrates the water system's managerial and financial capacity to comply with all drinking water regulations in effect, or likely to be in effect. The "business plan" shall be prepared in accordance with Appendix A of this publication and shall be updated at intervals determined by the Director;

3. "basis of design data" and "design calculations."

2.1.3 PHASE III - SOURCE APPROVAL SUBMITTALS

1. Submit a “Well Data Sheet" for the well, completed and signed by the water well contractor. The contractor must be licensed to construct water wells in the State of Georgia in accordance with the provisions of the Water Well Standards Act;

2. Physical and chemical "screening" of the raw water must be performed for the following parameters (with the concentrations shown in milligrams per liter (mg/1), where applicable) by an acceptable water laboratory, and a copy of the results submitted to this office:

pH	Zinc
Alkalinity (as $CACO_3$)	Iron
Hardness (as $CACO_3$)	Manganese
Chloride	Sulfate
Fluoride	Turbidity (NTUs)
Nitrate (as N)	Carbon dioxide
Nitrite (as N)	Color (color units)
Total Nitrate & Nitrite (as N)	Total Dissolved Solids

This "screened" analysis must be performed as an interim measure to determine usability of the well/spring as a potential source of water supply, until an in-depth testing of the water is completed as required by the U.S.E.P.A.'s Standardized Monitoring Framework;

3. A raw water sample must be collected from the proposed source and submitted to the Division's Water Supply Laboratory or other Division approved laboratory for microbiological analysis. A copy of the results must be submitted to the Drinking Water Permitting and Engineering Program;

4. A raw water sample must be collected in a specially marked one gallon plastic container and submitted to the Division's Radiological Laboratory for radiological analysis. The plastic container, necessary forms and instructions for this sampling are sent under separate cover.

5. Under certain circumstances, the Drinking Water Permitting and Engineering Program may request additional or special sampling of the proposed water source for physical, microbial, radiological and chemical analyses, including in-depth evaluation of the proposed water source for the influence of surface water.

6. In order to obtain a "microbiological sampling case" from the EPD laboratory, a "Water Sample Shipping Case Request" form must be completed and returned to either the Drinking Water Permitting and Engineering Program or the EPD Water Laboratory with a check or money order in the amount of $25.00, which is made payable to the Georgia Department of Natural Resources.

7. Those systems with a design capacity to use 100,000 gallons of water per day are required to make an application to obtain (or modify the existing) permit to use either groundwater or surface

water to reflect the addition of the new water source(s) and/or any change in the water withdrawal amount. Please contact the Division's Water Resources Management Program at (404) 656-3094 concerning requirements for the water withdrawal permit.

2.1.3.1 ADDITIONAL REQUIREMENTS FOR CITIES, COUNTIES and WATER AUTHORITIES:

8. Description of how the erosion and sedimentation control will be accomplished during and after construction of this project. Compliance with Act 599, "The Erosion and Sedimentation Act" (O.C.G.A. 12-7-1 et. seq.) is required. A land disturbing activity permit must be obtained (either from local government or EPD, as applicable) prior to start of any construction.

9. For any well or spring to be developed as a community public water supply source for a municipality, county, or an authority, written documentation must be provided from the EPD's Geologic Survey Branch [Tel# (404) 656-3214] that an appropriate wellhead protection area has been delineated and an inventory of potential pollution sources in the wellhead protection area of the proposed well/spring has been completed

NOTE: If all of the requested information (identified under "Phases II and III") is not received within one (1) year from the date of receipt of correspondence from the Drinking Water Permitting and Engineering Program, no further consideration will be given for the proposed water system development project. For reconsideration, a separate inquiry must be made to the Drinking Water Permitting and Engineering Program.

2.1.4 PHASE IV - PERMITTING & CONTRACT SERVICES SUBMITTALS

a. An "Application for a Permit to Operate a Public Water System" must be completed, signed and returned to the Drinking Water Permitting and Engineering Program.

b. Provide proof of ownership (a copy of warranty deed or bill of sale), when applicable.

c. To assure continuity of maintenance and operation of a non-governmentally owned community water system in compliance with the current and future state and federal drinking water regulations, the owner must submit a recorded copy of an executed TRUST INDENTURE or other legal agreement approved by the Division. This legal document should be executed with the local government in which the system is located. In the event the local government is not available, another trustee (acceptable to Division) can be used to assure the operation and maintenance of the system in conformance with the regulations. Please refer to the Rules for Safe Drinking Water, Chapter 391-3-5, concerning this requirement.

d. To obtain a "Drinking Water Service Contract", please contact the Drinking Water Program Fee Coordinator at (404) 656-4807. Under this "optional" contract, Georgia Environmental Protection Division (EPD) will provide for the laboratory and related services consistent with the OWNER's need to comply with the National Primary and Secondary Drinking Water Regulations and related regulations in the Georgia Rules for Safe Drinking Water, Chapter 391-3-5. Entering into this contract is not a condition or prerequisite to the permit nor will stop or prevent EPD from fulfilling its regulatory functions with regard to the public water system.

PART 3 - PROCEDURES FOR ADDITIONS AND EXTENSIONS TO PUBLIC WATER SYSTEMS

3.1.1 GENERAL: All engineering documents must be prepared as stated in this document by a professional engineer licensed to practice in the state of Georgia. Please refer to Part 1, titled "Submission of Engineering Documents" in this publication and the Rules for Safe Drinking Water, Chapter 391-3-5. Additional "specific" requirements may apply to those systems that are proposed for construction in the coastal region of Georgia. For those specific requirements, please contact the Environmental Protection Division.

The following shall be submitted, as applicable:

a. detailed plans and specifications for the construction of the water system project. Engineering plans must be applicable to the project and may include water supply sources [i.e.well(s), spring(s)], treatment, storage, distribution system indicating the size of all water lines, valves, feeder mains, service lines, blow-off valves, booster pump stations, point of tie-in, and any other information pertinent to the project. Specifications should pertain to materials, construction methods, disinfection and pressure testing of water lines, valves, pumps, controls, treatment and appurtenances, as applicable to the project. If previously approved standard specifications apply, a statement to that effect should be included in the submittal cover letter;

b. when required by the Director, a "business plan" (see Appendix A) which adequately demonstrates the water system's managerial and financial capacity to comply with all drinking water regulations in effect, or likely to be in effect. The "business plan" shall be prepared in accordance with Appendix A of this publication and shall be updated at intervals determined by the Director, as specified in Section 391-3-5-.04 of the Rules for Safe Drinking Water;

c. "basis of design data", as well as "design calculations" and "hydraulic analysis" for the project;

d. "evidence of availability of water". Requests for approval of subdivisions (connecting to existing distribution systems) must include documentation that the project has been coordinated with the supplying water system. A twenty-four hour pressure test chart and flow information which was taken at a point nearest to the tie-in of the existing system, must be submitted.

e. a copy of the completed form, titled "Water System Addition and Expansion Form". All applicable information pertinent to the project must be provided on this form.

3.1.2 WATER SYSTEM ADDITION and EXPANSION FORM

General information

Project Name: ____WSID No.:______________

Project Location:______________________________________ County:________________

Latitude:_________________Longitude:_________________ (wells only)

Developer:__________________________________

Type of Development:____

Design Information

Number of Sources:_________________Total Production Capacity:______________ (gpm)

Number of Service Connections Proposed:_________________

Number of Service Connections Existing:_________________

Treatment Type:_________________

Storage Type:_________________ Total Volume:_________________ (gallons)

Maximum Elevation in Development: ________________(feet)

Size(s) of Water Main in Project:_________________(inches)

Length of Water Main to be Installed:_________________(feet)

Wastewater for this Project will be handled by: Septic Tank:____ or Sewer System:____

If the project is to be supplied by an existing water system, please include the following:

Water System Supplier's Name:_________________WSID Number:________________

Static Pressure (point of tie-in): __________(psi) at ____________feet elevation

Elevation at the point of tie-in: ______________feet

Flow Available:____________(gpm) at ________________ (psi) residual

Size of Water Main at Point of Tie-in to Project: _________________

PART 4 - GENERAL DESIGN CONSIDERATIONS

4.1.1 PLANT LAYOUT - System design shall consider:

a. functional aspects of plant layout;

b. provisions for future plant expansion;

c. access roads;

d. site grading;

e. site drainage;

f. walks;

g. driveways and parking;

h. chemical delivery.

4.1.2 BUILDING LAYOUT - Design shall provide:

a. adequate ventilation, which is screened for insect protection;

b. adequate lighting;

c. adequate heating and air-conditioning;

d. adequate drainage;

e. dehumidification equipment as needed;

f. accessibility of equipment for operation, servicing, and removal;

g. flexibility of operation;

h. operator safety, including safety railings;

i. convenience of operation;

j. consideration of chemical storage and feed equipment in separate rooms to reduce dust problems;

k. separate facilities for laboratory procedures and office/lunch activities.

4.1.3 STANDBY POWER - Stand-by power generation may be required by the Division so that water may be treated and/or pumped to the distribution system during periods when there is a power outage.

4.1.4 EQUIPMENT MAINTENANCE - Adequate facilities shall be available for the maintenance and servicing of automation equipment.

4.1.5 STORAGE AND SHOP SPACE - Adequate facilities shall be included for shop space and storage consistent with the designed facilities.

4.1.6 PROVISIONS FOR FUTURE EXPANSION - Consideration shall be given to facilitate expansion and unknown future uses whenever pipes pass through walls of concrete structures.

4.1.7 METERING - All water systems shall have some means of metering the raw and finished water. In addition, all new services connected to community and nontransient, noncommunity water systems shall be metered. Existing services should be metered, if not metered already. In the event existing services are not metered, metering shall be performed when required by the Director of the Environmental Protection Division.

4.1.8 SOURCE - To enhance reliability of the water supply, all community public water systems with groundwater sources shall provide an approved back-up water supply source that is capable of providing adequate water service in the event the primary source becomes nonfunctional.

PART 5 - SOURCE DEVELOPMENT

5.1.1 GENERAL - In selecting a source of water to be developed, the design engineer must show, to the satisfaction of the Division, that the water which is to be delivered to the consumers shall meet the state and federal drinking water standards with respect to bacteriological, physical, chemical and radiological quality requirements. The Environmental Protection Division shall evaluate and approve proposed new sources before they are placed into service as drinking water sources.

a. All sources of water supply must be adequate to meet anticipated growth. For human consumption in a community water system, one hundred (100) gallons per day for the projected population to be served at the end of the design period shall be considered adequate.

b. Any community public water system using groundwater sources and serving 25 or more service connections shall provide an approved back-up water source, such as an additional well, capable of providing adequate water service if the primary source becomes nonfunctional.

5.2.0 **SURFACE WATER** - A surface water source includes all tributary streams and drainage basins, natural lakes and artificial reservoirs or impoundments above the point of water supply intake.

5.2.1 QUANTITY - The quantity of water at the source shall:

a. be adequate to supply the water demand of the service area;

b. provide a reasonable surplus for the anticipated growth over a design period of 20 years;

c. be adequate to compensate for all losses.

5.2.2 QUALITY - A sanitary survey and study should be made of the factors, both natural and man made, which will affect quality. Such survey and study, shall include, but shall not be limited to:

a. obtaining samples over a sufficient period of time to assess the bacteriological, physical, chemical and radiological characteristics of the water.

b. assessing the degree of hazard to the supply by accidental spillage of materials that may be toxic, harmful or detrimental to the treatment processes.

c. complete the items listed under 5.2.2.1 which are considered minimum requirements for determining the acceptability of the proposed surface water source. Additional water quality monitoring, studies, investigations and evaluations should be conducted before selecting and/or designing appropriate treatment processes and technologies.

5.2.2.1 GENERAL: In accordance with Section 391-3-5-.06 of the Rules for Safe Drinking Water, promulgated under the Georgia Safe Drinking Water Act of 1977, the source of water supply for all public water systems must have the approval of the Environmental Protection Division. Before a proposed surface water supply can be considered for acceptance as a potential source of public water supply, the items below must be addressed to the satisfaction of the Division.

a. A written request to evaluate the water supply as a potential source of public water supply and a map showing the geographical location of the proposed water intake must be submitted to the Drinking Water Program.

b. A survey of the water drainage basin supplying the intake which addresses the current level of watershed protection; the nature of upstream land use; the existing and potential sources of pollution; and, other pertinent conditions which may have an impact on the use of the site as a potential water supply source must be submitted to the Division.

c. One (1) raw water sample must be collected at least every two (2) weeks for six (6) months from a point most representative of the proposed intake location and submitted to the Division's Water Supply Laboratory or other Division approved laboratory for microbiological analysis [total coliform and fecal coliform or Escherichia coli (E. coli)] and turbidity. Additional samples must be collected after each rain event for microbiological and turbidity analysis, and any other parameter that would be considered pertinent due to geographical location of the intake.

d. When required by EPD, one raw water sample shall be collected every month for six (6) months, from a point most representative of the proposed intake location and tested for *Giardia* cysts, *Cryptosporidium* oocysts, and Enteroviruses concentrations.

e. One (1) raw water sample must be collected from the proposed intake location in a specially marked one gallon plastic container and submitted to the Division's Radiological Laboratory for radiological analysis. The plastic container, necessary forms and instructions for this sampling will be sent to you under separate cover.

f. Physical and chemical screening of the proposed source water must be performed for at least for two (2) quarters for the following parameters (with the concentrations shown in mg/L, where applicable) by a water laboratory, and a copy of the results submitted to this office:

pH	Zinc
Alkalinity (as $CACO_3$)	Iron
Hardness (as $CACO_3$)	Manganese
Chloride	Sulfate
Fluoride	Turbidity (NTUs)
Nitrate (as N)	Carbon dioxide
Nitrite (as N)	Color (color units)
Total Nitrate & Nitrite (as N)	Total Dissolved Solids

This "screened" analysis is performed as an interim measure to determine usability of the proposed supply as a potential source of public water supply. Additional tests or in-depth water quality analysis may be required by state and federal drinking water regulations.

g. When required by EPD, raw water samples shall be collected from the proposed intake location for two (2) quarters and tested for Total Organic Carbon (TOC), Total Organic Halide (TOX), Bromide and Ammonia.

h. Contact the Drinking Water Permitting and Engineering Program for any special sampling requirements of the proposed water source for physical and/or chemical analyses.

i. Upon completion of sampling of the proposed water source and water drainage basin survey, tabulate all the laboratory results (with special reference to fluctuations in quality and possible sources of contamination) and other pertinent findings in an engineering report and submit it to EPD along with the engineer's comments and treatment design recommendations. In addition to water source information, this engineering report should be comprehensive enough to include, but not limited to, general project information (i. e. water use, flow requirements, etc.); describe the nature and extent of the proposed water works project; discuss the alternate plans, giving reasons for selecting the one recommended; summarize and establish the adequacy of proposed treatment processes and unit parameters for the treatment of the specific water source under consideration (pilot studies, conducted over a sufficient time to treat under all expected raw water conditions throughout the year, may be necessary to demonstrate satisfactory performance); discuss the various wastes from the water treatment plant, their volume, proposed treatment and points of discharge; discuss the various sites considered and advantages of the recommended ones; summarize planning for future needs and services; etc.

j. Submit an application to obtain a permit to use surface water. Please contact the Division's Water Resources Management Program at (404) 656-3094 concerning the water withdrawal permit requirements.

5.2.2.2 Please be reminded, the above outlined testing program is a basic screening process to evaluate the suitability of a surface source proposed for use as a public drinking water supply.

Additional water quality testing should be performed to determine treatment characteristics, chemical dosages, primary (and secondary coagulants), pH adjustments, etc. Information such as these, in conjunction with the source approval data, should be used to select and design appropriate water treatment technologies.

5.2.2.3 STRUCTURES - Intake structure design shall:

a. provide withdrawal of water from more than one level;

b. provide adequate protection against rupture by dragging anchors, ice, etc.;

c. have motors and electrical controls located above grade and flood level except when submersible pumps are approved;

d. be accessible;

e. be designed against flotation;

f. be equipped with removable or traveling screens before the pump suction well;

g. provide chemical feed facilities (i.e. chlorine, potassium permanganate) for pretreatment and/or raw water transmission main, as necessary for water quality control;

h. have intake valves and provisions for backflushing and testing for leaks, where practical;

i. have provisions for surges where necessary;

j. have provisions for sand or gravel removal;

k. provide protection against any influence from a sewage outfall.

5.2.2.4 IMPOUNDMENTS AND RESERVOIRS

a. Site preparation should provide for:

 1. removal of brush and trees to high water elevation;
 2. protection from floods during construction;
 3. clearing and grubbing small reservoirs.

b. Construction may require:

 1. approval, obtained from the Division, of safety features for stability and spillway design of any structures;

2. a permit for controlling stream flow or the structure on the bed of a navigable stream or interstate water, to be obtained from the appropriate agency.

5.3.0 **<u>GROUND WATER</u>** - A ground water source includes all water obtained from drilled wells or springs. Dug, bored, or jetted wells are prohibited for all public water systems.

5.3.1 <u>GENERAL</u>

a. The person constructing the well must be a licensed water well contractor in the State of Georgia in accordance with the provisions of the Water Well Standards Act of 1985 (O.C.G.A. 12-5-120, et. seq.). The contractor must maintain accurate driller logs, including material setting and grouting data, complete the results of the pump test, including water level measurements, and must furnish a signed copy of the results to the owner and to the Division on forms provided by the Division.

b. Ground water sources (wells and springs) shall be evaluated for direct influence of surface water, when required by the Division.

c. Two important concerns in the design of water wells must be adequately addressed:

   1. The provision for the proper depth to which the well casing shall be installed as a watertight conduit, and

   2. The provision for positive sealing of the annular space between the outside of the well casing and the well hole to prevent movement of water vertically along the outside of the well casing pipe. The well must be protected from contamination by surface waters and other sources of contamination.

5.3.2 <u>WELLS SHALL BE LOCATED:</u>

a. generally at the highest point, and as far removed, and in a direction opposite to the ground water flow from any known or probable source of contamination;

b. not less than fifty (50) feet from a septic tank;

c. not less than one hundred (100) feet away from a septic tank absorption field;

d. not less than ten (10) feet away from a sewer;

e. not less than one thousand (1,000) feet away from a solid waste disposal site and not in a direction where ground water flow from the site may be intercepted by the well;

f. as far removed as possible from all open abandoned wells;

g. not in areas of sink holes;

h. not in the flood plain areas, unless adequate protection is provided to prevent submergence of the well casing, pumps and appurtenances;

i. not less than 100 feet from surface water;

j. not less than 100 feet from buildings, mobile homes, permanent structures, animal houses or lots, or cultivated areas to which chemicals are applied;

k. not less than 100 feet from a chemical or petroleum fuel underground storage tank with secondary containment;

l. the Division may require greater separation distances or impose other protective measures when necessary to protect the well from any potential source of pollution, based upon: the hazard or health risk associated with the source of pollution; the proximity of the potential source to the well; the type of material, facility or circumstance that poses the source or potential source of pollution; the volume or size of the source or potential source of pollution; hydrogeological features of the site which could affect the movement of contaminants to the source water; the effect which well operation might have on the movement of contamination; and, the feasibility of providing additional separation distances or protective measures;

m. the well, and the associated pumping and water treatment equipment shall be protected from unauthorized entry and use by an enclosed shelter or enclosed by a fence. The water treatment equipment shall be enclosed in a weatherproof shelter.

5.3.3 <u>WELL ABANDONMENT</u>

a. Wells not used as sources of water supply shall be filled, plugged and sealed to protect against contamination of the ground water.

b. Wells to be abandoned shall be sealed to prevent undesirable exchange of water from one aquifer to another.

c. Preferably the well hole should be filled with neat cement grout.

d. Have fill materials other than cement grout or concrete, disinfected and free of foreign materials.

e. When filled with cement grout or concrete, these materials shall be applied to the well hole through a pipe, tremie, or bailer.

5.3.4 GENERAL WELL CONSTRUCTION

a. All public water supply wells must be constructed in accordance with the requirements of the Georgia Rules for Safe Drinking Water, Chapter 391-3-5, by a water well contractor licensed in the State of Georgia.

b. Pitless adapter wells shall not be constructed for public water supply systems.

c. Wells shall be tested for plumbness and alignment in accordance with the latest edition of AWWA A100 Standard.

d. Drilling fluids must be from an uncontaminated source or must be disinfected.

e. All permanent casing, liners, screens and other manufactured material used in the well installation must be new. Material used shall preferably be wrought iron or steel.

f. All casing and liner pipe joints shall be water tight the entire length in drilled wells. They shall have full circumferential welds or threaded coupling joints.

g. The well casing shall neither terminate below ground nor in a pit.

h. Packers shall be of a material that will not impart taste, odor, toxic substances or bacterial contamination to the water in the well.

i. During the periods of stoppage of the well construction and when the site is unattended, the drilling contractor must have the well opening securely covered to prevent tampering and possible contamination. A welded metal plate is preferred for capping a well.

j. During the well construction, the premises, construction material, tools and equipment must be maintained in a sanitary manner to prevent contamination of the well by the person excavating the well.

k. The pump house floor shall be at least one foot above the original ground surface and not less than two feet above the highest known flood elevation.

5.3.4.1 STEEL CASING

a. Steel pipe well casing shall conform to American Society for Testing and Materials (ASTM) Specification A 120 or A 53 or American Petroleum Institute (API) Specification 5L or 5LS or equal standard and meet the following minimum wall thickness unless otherwise approved by the Division:

Nominal Casing Diameter (in inches)	Minimum Wall Thickness (in inches)
4	0.188
5	0.188
6	0.188
8	0.219
10	0.250
12	0.250
14	0.312
16	0.312
18	0.375
20	0.375
24	0.375

5.3.4.2 PLASTIC PIPE CASING

a. The use of plastic well casing and screens must be approved by the Division prior to well installation.

b. The plastic well casing and couplings shall meet the requirements of the ASTM Standard F 480 or equal standard and the National Sanitation Foundation standard for use with potable water.

c. Any approved plastic well casing shall conform to the following minimum wall thickness:

Nominal Casing Diameter (in inches)	Minimum Wall Thickness (in inches)
4	0.265
4.5	0.291
6	0.390
8	0.508
10	0.632
12	0.750

d. The plastic well casing and screen shall not extend to a depth of greater than 300 feet below the ground surface.

5.3.4.3 CASING DEPTH AND GROUTING

a. The outer, permanent, protective casing shall extend at least five (5) feet into the first solid, unweathered or impervious subsurface rock strata encountered, and shall have a minimum length of twenty-five (25) feet from the ground surface into a well excavated into water-bearing formations in crystalline rocks and fifty (50) feet in a well excavated into sedimentary water-bearing formations.

b. The outer, permanent, protective casing shall be cement grouted its entire length with a cement slurry consisting of not more than six (6) gallons of water to one cubic foot of cement, plus standard additives, when necessary, to facilitate placing or setting. The neat cement shall conform to ASTM Standard C150.

c. The outer protective casing shall be provided with sufficient guides or centralizers attached or welded to the casing to permit unobstructed flow and uniform thickness of grout.

d. The guides or centralizers shall be attached to the bottom of the casing and at intervals not greater than 25 feet.

e. The grout shall be placed under pressure by a positive displacement method, such as pumping, from the bottom of the annular space upward until the grout is extruded at the earth's surface in one continuous operation.

f. The wall thickness of the cement grout surrounding the outer, permanent, protective casing shall be not less than one and one-half (1-1/2) inches at any point.

g. Subsurface well construction shall cease for at least twenty-four (24) hours after grouting.

5.3.4.4. GRAVEL PACK WELLS

a. The gravel for gravel-packed wells must be washed, free of organic matter, and composed of well rounded particles which are 95% siliceous material.

b. Gravel shall be properly sized and disinfected immediately prior to or during placement.

c. Gravel pack shall be placed in one uniform continuous operation.

d. Gravel refill pipes, when used, shall be Schedule 40 steel pipe incorporated within the pump foundation and terminated with screwed or welded caps at least 12 inches above the pump house floor or concrete apron.

e. Gravel refill pipes located in the grouted annular opening shall be surrounded by a minimum 1-1/2 inches of grout.

f. Protection from leakage of grout into the gravel pack or screen shall be provided.

5.3.4.4.1 WELL SCREENS

a. Shall be constructed of material which will not be damaged by the chemical action of ground water or future cleaning operations;

b. Have the size of openings based on sieve analysis of the formation and/or based on the size of gravel if any artificial gravel pack is installed;

c. 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;

d. Be installed so that the pumping water level remains above the screen under all operating conditions;

e. Be designed and installed to permit removal or replacement without adversely affecting the water-tight construction of the well;

f. Be provided with a bottom plate or washdown bottom fitting of the same material as the screen.

5.3.4.5 WELL DEVELOPMENT

a. The well shall be properly developed, disinfected, and pump tested by the drilling contractor.

b. Development of the well shall accomplish removal of native silts and clays, drilling mud or finer fraction of the gravel pack, and shall continue until the maximum specific capacity is obtained from the completed well.

c. Every well shall be tested for yield and drawdown. The static water level, drawdown and pumping water level must be measured.

d. The well shall be test pumped at not less than the desired yield for a period of at least twenty-four (24) hours and shall continue for at least four (4) hours after the pumping level has stabilized.

e. The methods of testing shall include but are not limited to the following:

    1. Constant Discharge Method - This type of test is preferred for wells completed in unconsolidated aquifers. It is made by maintaining a constant rate of discharge equal to or greater than the desired yield of the well throughout the entire period of pumping. Measurements of pumping rate and water level shall be made every minute for the first 10 minutes of the test, every 2 minutes for the next 10 minutes, every 5 minutes for the next 40 minutes, every 15 minutes for the next hour, every 30 minutes for the next 3 hours, hourly for the remainder of the pumping period.

Recovery water-level measurements shall be made with the same frequency beginning with the cessation of pumping and continuing until complete recovery has occurred or until sufficient data have been collected to extrapolate full recovery.

2. Step Drawdown Method - This method is preferred for wells completed in consolidated rock formations. It involves the well being "step" tested at rates approximately 1/2, 1, and 1-1/2 times the design capacity of the well. Each step should consist of equal periods of pumping except the final step may be continued for a longer period of time if desired by the owner. The pump is operated continuously for the entire period of the test. The discharge must be controlled with a gate valve, if electric driven, or a gate valve and throttle if engine driven. The discharge is controlled and maintained at approximately the desired discharge for each step with an accuracy of + 5 percent. Pump discharge is measured with a meter such as a circular orifice meter that will permit instantaneous determination of the discharge rate. A half-inch I.D. or larger pipe is installed from a point about 2 feet above the pump intake to the well head. The top of the pipe is readily accessible to insert remove and read the depth to water using either a steel tape or 2-wire electric sonde. Measurements of pumping rate and water level are made for each step of the test according to the schedule given in the constant discharge method. Recovery water-level measurements are made with the same frequency until the well has fully recovered or until sufficient data have been recovered to extrapolate full recovery. The test pump shall be capable of pumping 150 percent of the desired yield of the well.

f. The pumping equipment shall be capable of operating continuously without interruption for the maximum period contemplated for the test.

g. Data shall be provided to the Division on the forms furnished by the Division.

5.3.4.6 WELL DISINFECTION

a. The well must be disinfected prior to the pumping test by the introduction of a chlorine solution into the well under sufficient pressure to overcome the natural flow pressures of all developed water-bearing zones, and in sufficient quantity to produce a minimum chlorine residual of fifty (50) parts per million (mg/L) in six (6) hours after such application.

b. Table to determine chlorine compound necessary to dose 100 feet of water-filled well at 50 mg/L:

Well-Hole or Well-Casing Diameter (in inches)	Volume Per 100 ft Of Water Depth (in gallons)	Amount of Chemical Compound		
		Calcium Hypochlorite (65% avail. Cl_2)	Sodium Hypochlorite (12 trade %)	Liquid Chlorine (100% avail. Cl_2) (in pounds)
4	65.28	0.7 oz	3.5 fl oz	0.03
6	146.9	1.5 oz	7.8 fl oz	0.06
8	261.1	2.7 oz	13.9 fl oz	0.11
10	408.0	4.2 oz	1.4 pt	0.17
12	587.5	6.0 oz	2.0 pt	0.25
16	1044.0	10.7 oz	3.5 pt	0.44
20	1632.0	1 lb 1 oz	0.7 gal	0.68
24	2350.0	1 lb 8 oz	1.0 gal	0.98
30	3672.0	2 lb 6 oz	1.5 gal	1.53

c. After disinfection, the well must be pumped until no trace of chlorine remains in the water, nor in the water samples taken for microbiological analysis. If the water samples submitted are found to be unsatisfactory, the disinfection procedure must be repeated.

d. The permanent pump and pumping equipment shall be disinfected with a chlorine solution prior to being placed into service.

5.3.4.7 WELL APPURTENANCES

a. A concrete slab with a minimum thickness of six (6) inches shall be constructed around the well casing and shall extend at least two (2) feet in all directions, sloping away from the casing.

b. The well casing shall extend at least twelve (12) inches above the concrete slab of the floor.

c. When 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.

d. For submersible pump installations, the well casing shall be provided with a sealed cover plate and, vented by a screened riser pipe so that the screened opening terminates downward at least twelve (12) inches above the top of the casing or ground level.

e. For turbine pump installations, a concrete block to support the pump motor shall be constructed around the outer well casing, shall extend at least twelve (12) inches above the concrete slab, and:

   1. the outer casing shall extend at least one (1) inch above the pump motor block;

2. the well head and pump base shall be sealed to prevent seepage and the casing shall be vented by a screened riser pipe so that the screen opening terminates downward and above any point of back flow of contaminants into the well; and,

3. oil lubricated vertical turbine pumps shall be lubricated with an acceptable turbine oil as prescribed by the pump manufacturer.

5.3.4.7.1 DISCHARGE PIPING SHALL:

a. be designed to keep friction losses at minimum;

b. be equipped with a check valve, a shutoff valve, a pressure gauge and a means of measuring flow (water meter);

c. be provided with a raw water sampling tap prior to the well discharge pipe check valve;

d. where applicable, 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 18 inches above the floor and covered with a 24 mesh corrosion resistant screen;

e. have an access port of not less than five-eighths (5/8) inch in diameter, with screw cap, for water level measurements; a deep well air line and gage may also be used in conjunction with the access port;

f. where pneumatic water level measuring equipment is used, it shall be manufactured using corrosion resistant materials attached firmly to the drop pipe or pump column and in such a manner as to prevent the entrance of foreign materials;

g. have all chemical injection ports located down stream from the well discharge pipe check valve;

h. have control valves and appurtenances located above the pumphouse floor;

i. have all exposed piping, valves and appurtenances protected against physical damage or freezing;

j. be properly anchored to prevent movement;

k. be protected against surge or water hammer;

l. be valved or have means of pumping to waste (a blow-off), but shall not be directly connected to a sewer.

5.4.0 SPRINGS

a. Springs must be protected by an enclosed structure. The walls of the structure must extend down to bedrock, or into the soil sufficiently to provide for a proper foundation to prevent surface water infiltration.

b. All surface water run-off must be diverted from the spring.

c. The spring must be protected from any entry of surface water.

d. The overflow from the spring's enclosed structure must be designed to prevent entrance of contaminants or animals.

e. A chlorine contact time of at least 30 minutes shall be provided.

f. Continuous turbidity monitoring shall be provided with an automatic cutoff at 1.0 NTU.

g. The pumping and water treatment facilities must be enclosed in shelters that are of weather and vandal-proof construction.

h. The spring area must be secured to prevent unauthorized entry.

PART 6 - DESIGN CAPACITIES and WATER DEMANDS

6.1.1 GENERAL – An important factor in the planning and design of a water system is an accurate estimate of the quantities of water which must be supplied to meet water needs. These estimates are pivotal to the entire design including the production of water, pumping, treatment, storage, and the distribution system. Each water system component is designed to meet certain flow requirements and to insure that water will be available at the various water use points throughout the system in adequate quantities to meet demands.

6.1.2 ESTIMATING BASIC WATER DEMANDS

a. The various components of a water system are designed to meet specific water flow criteria which are dependent upon the type of water system and the objectives of the system.

b. Average Daily Demand expresses the quantity of water used in a system in an average day. It is based upon experience from water meter readings in similar water systems over an extended period of time and reflects the normal seasonal and daily variations. For design purposes, it is usually determined by estimating the population or units of housing or other units and multiplying by an average per person or per unit water consumption derived from past experience. The average daily demand will be exceeded on many days (during peak demands), so it is not appropriate to design merely for the average. The greatest amount of water usage in one day or other period of time must be considered.

The following provides a guide for estimating the average daily demand for various types of establishments, in gallons per day per unit. The unit is persons per day unless otherwise indicated. The values are for normal water requirements and do not include special needs or unusual conditions. Additional allowances should be made for fire fighting, lawn watering, swimming pool, industrial or commercial process water and other special uses.

Type of Establishment (The unit is per person unless otherwise stated)	Average Daily Use (gallons per day)
Airport (per passenger)	3-5
Assembly Halls (per seat)	2
Camps - Children, overnight, central facilities	40-50
- Construction	50
- Migrant Labor	35-50
- Day type, no meals served	15
Churches (per member)	1
Cottages, season occupancy	50
Clubs - Residential	100
- Non residential	25
Factories, sanitary uses, per shift	15-35

Type of Establishment (The unit is per person unless otherwise stated)	Average Daily Use (gallons per day)
Food Service – Restaurants	7-10
- With bars	9-12
- Fast Food	2
Highway Rest Areas	5
Hotels (2 persons per room)	60
Institutions – Hospitals (per bed)	250-400
-Nursing Homes (per bed)	150-200
- Others	75-125
Office Buildings	15-30
Laundries, self service (per customer)	50
Motels (per bed)	60
Parks – Day use (with flush toilets)	5
- Mobile Homes (per unit)	200
- Travel trailers (per unit)	90-100
Picnic Areas (with flush toilets)	5-10
Residential Communities	
Single Family Dwelling (per person)	100
- Single Family Dwelling (per house maximum)	400
- Multi-family (per bedroom)	120
- Rooming house/tourist home (per bedroom)	120
Resort Motels and Hotels	75-100
Retail Stores (per toilet room)	400
Schools – Day, no showers or cafeteria	15
- Day, with cafeteria	20
- Day, with showers and cafeteria	25
- Residential types	75-100
Shopping centers, per sq. ft. sales area	0.16
Swimming Pools and Beaches	10
Theaters – Drive-in (per car)	3-5
- Others (per seat)	3

c. Maximum Daily Demand expresses the greatest amount of water a system will use in one day. Small residential water systems may experience that their maximum day is 1.5 to 2 times the average day. However, this ratio may not apply to other types of water systems. In general, the smaller the water system, the greater the variation between the average and the maximum day.

d. Maximum Hourly Demand expresses the greatest amount of water which will be used in any hour during the day. This is sometimes referred to as the peak hour demand, although there will be short term peak demand rates lasting for several minutes which will exceed the maximum hourly demand rate. Each type of system exhibits its own maximum hourly and short term peak demands and the hours of peak occurrence will vary. For example, shopping centers usually experience hourly peaks in the early afternoon while residential communities may experience two peak hours, about 8:00 a.m. and 6:00 p.m. The maximum hourly demand is often expressed as a ratio of the average daily demand, in gallons per minute. Generally speaking, the smaller the water system, the greater the maximum hour rate in respect to the average daily rate. The peak hourly demand at small residential communities may range about 6 to over 10 times the average daily demand.

e. Peak Demand (instantaneous demand) is the maximum amount of water necessary to meet the peak short term demand rate which may occur several times during a day, usually occurring during the peak hour period. The instantaneous peak may last for several minutes. The rate is particularly important in considering the sizing of the storage tank in a hydropneumatic system. The effective storage capacity is usually designed to meet these short term peaks. The minimum effective storage volume of pressure tanks, in gallons, shall equal the peak demand, in gallons per minute (gpm), minus the pumping capacity (gpm), multiplied by 20. In the absence of sufficient effective storage to meet extended peak demands, the wells and pumps must be capable of meeting the peak demands. The smaller the water system, the greater the ratio of the peak demand to the average demand.

INSTANTANEOUS (PEAK) DEMAND FOR RESIDENTIAL COMMUNITIES

Number of Connections	Gallons Per Minute
10	40
15	50
20	58
25	66
30	73
35	80
40	85
45	91
50	96
55	101
60	106
70	115
80	124
90	132
100	140
125	160
150	175
175	195
200	205
250	230
300	255
400	295
500	335

Note: It should be noted that fire flow is not included in the definition of average daily and maximum daily demands and should be added if fire protection is desired. Fire flows are usually expressed as gallons per minute to fight a fire of a certain duration, and could be designed into a water system for fire fighting purposes. Local fire underwriters could provide specific requirements on request.

INSTANTANEOUS (PEAK) DEMAND FOR MOBILE HOME PARK WATER SYSTEMS

Number of Connections	Gallons Per Minute
10	25
15	31
20	37
25	42
30	46
35	50
40	54
45	57
50	60
55	64
60	66
70	72
80	78
90	84
100	88
125	100
150	110
200	128
250	145
300	160

INSTANTANEOUS (PEAK) DEMAND FOR CAMPGROUND & TRAVEL TRAILER WATER SYSTEMS

Number of Connections	Gallons Per Minute
20	25
25	32
40	38
50	43
60	47
80	55
100	60
120	69
140	73
160	80
180	85
200	90
300	110
400	130
600	163

PART 7 - DISTRIBUTION SYSTEMS

7.1.0 SYSTEM DESIGN

7.1.1. MINIMUM PIPE SIZE

a. The water distribution system must be designed and the water lines sized to furnish at all times the instantaneous demand flow of water required under all conditions of flow.

b. The minimum size of pipe for principal water mains and for water mains where fire hydrants are to be attached shall be 6-inch diameter.

c. The minimum size water main shall be two (2) inches in nominal diameter. However, the size of water mains shall be justified by hydraulic analysis, performed by a professional engineer. The 2-inch water mains shall be considered for short cul-de-sacs and permanent dead-ends where future growth is not feasible.

d. Generally, not more than 20, or the equivalent of 20, residences shall be connected to a 2-inch diameter water line, unless the main is looped or otherwise supplied from two connections with mains of adequate capacities. A looped 2-inch main shall serve no more than 40 residences, or the equivalent water demand of 40 residences. A 2-inch diameter main shall not exceed 1000 feet in length.

e. All water mains, including those not designed to provide fire protection, shall be sized after a hydraulic analysis based on flow demands and pressure requirements has been completed.

f. The system must be designed to maintain a minimum pressure of 20 psi at each service connection and at all points in distribution system under all conditions of flow. The normal working pressure in the distribution system should be approximately 60 psi and not less than 35 psi.

g. Wide variations in pressure above the minimum requirement of 20 psi may be inherent in the design of a distribution system but pressures no greater than 100 psi should be delivered to the customer (unless higher pressures are requested.) The 100 psi maximum pressures can be met by pressure reducing valves in vicinity of each customer's source line, or by designing the distribution system to limit the maximum pressure.

h. All assumptions and any flow data used must be clearly documented and submitted with the hydraulic analysis. If actual flow data is not available, theoretical calculations shall be based on all storage facilities half-full and the Hazen-Williams friction factor appropriate for type of pipe being used but in no case greater than 130.

i. Water mains and distribution systems should be sized to meet instantaneous peak demand flows. When fire protection is to be provided, system design should consider the recommendations of Insurance Underwriters organization.

j. Fire hydrants shall meet the current AWWA Standard C502.

7.1.2 DEAD ENDS

a. Dead ends shall be minimized by making appropriate tie-ins whenever practical.

b. Where dead-end mains occur, they shall be provided with a fire hydrant, when fire flows are available, or with an acceptable flushing hydrant or blow-off for flushing purposes. The blow-off shall be at least 2 inches in diameter, but must be appropriately sized to provide flushing velocities of 2.5 feet per second or greater in the water main being flushed.

c. No flushing device shall be directly connected to any sewer nor be subjected to flooding or plugging.

7.2.0 INSTALLATION OF MAINS

a. Water lines must not be installed in contaminated areas such as sanitary landfill or dump areas.

b. No water main or pipe shall pass through or come into contact with any part of a sewer or sewer manhole.

c. A continuous and uniform bedding shall be provided in the trench for all buried pipe.

d. Backfill material shall be tamped in layers around the pipe and to a sufficient height above the pipe to adequately support and protect pipe.

e. Thrust restraint shall be provided at all points where hydraulic thrust may develop. This will include providing reaction blocking, tie rods or joints designed to prevent movement to all bends, tees, valves, plugs, hydrants and other points where thrust may develop.

f. Whenever a state route or heavily traveled off-system road or a rail-road is crossed, the agency that has jurisdiction over the road or the rail-road must be notified, prior to the installation of the mains. At the crossing, a steel casing with sufficient diameter must be jacked and bored to accommodate the carrier pipe. Any free boring at low traffic city streets and county roads must conform to the applicable local and/or state requirements.

g. Installation of water lines and appurtenances along highways, streets and roadways must comply with the applicable regulations of, and permits issued by, the Georgia Department of Transportation, local County and Municipality with reference to construction operations, safety, traffic control, road maintenance and repair.

h. When non-metallic pipe is installed, detection tape or other acceptable means of detection shall be installed.

i. Any pipe, solder or flux which is used in the installation or repair of the public water distribution system shall be lead free with not more than 8.0% lead in pipes and fittings and not more than 0.2% lead in solders and flux.

j. Following installation, all new and repaired water lines and appurtenances shall be flushed, pressure tested and disinfected. Samples shall be collected and tested for satisfactory microbiological quality of the water, prior to placing the lines into service.

7.2.1 ROCK EXCAVATION - Stones found in the trench shall be removed for a depth of at least six (6) inches below the bottom of the pipe.

7.2.2 COVER – All distribution mains shall be provided with sufficient earth and other suitable cover to prevent freezing. This shall be not less than 24 inches measured above the top of pipe.

7.2.3 HYDROSTATIC TESTS

a. Pressure and leakage tests shall be performed in accordance with the latest edition of AWWA Standard C600.

b. The test pressure of the installed pipe shall be a minimum 1.5 times the working pressure, but not less than 150 psi, whichever is greater.

c. Allowable leakage shall be no greater than as calculated in $L=SD\,(P)^{1/2}/133{,}200$ where L is allowable leakage in gallons/hour, S is the length of pipe tested in feet, D is pipe diameter in inches and P is test pressure during the leakage test in pounds per square inch (psi).

7.2.4 DISINFECTION OF WATER MAINS

a. All new water mains, as well as those taken out of service for inspection, repair or other activities that might lead to contamination of water shall be disinfected before they are placed in or returned to service.

b. Disinfection of the new mains and the disposal of the heavily chlorinated water, following the disinfection, shall be accomplished in accordance with the latest edition of AWWA Standard C651.

c. The “tablet method” of disinfection which consists of placing calcium hypochlorite granules or tablets in the water main as it is being installed and then filling the main with potable water when installation is complete is not allowed.

d. Before the main is chlorinated, it shall be filled to eliminate air pockets and shall be flushed to remove particulates. A flushing velocity of not less than 2.5 feet/second is usually maintained in pipe sizes less than 24 inches in diameter. For larger diameter mains, an alternative to flushing, such as broom-sweeping of the main, is acceptable prior to chlorinating the main.

e. During disinfection of the water mains, an appropriate cross-connection control device, consistent with the degree of hazard, shall be provided for backflow protection of the active distribution system.

f. The quality of the water used during the disinfection procedures shall meet the required drinking water standards.

g. The chlorine solution used for disinfection of water mains shall have a free chlorine residual concentration not less than 25 mg/L. This heavily chlorinated water shall be retained in the main for at least 24 hours, during which time all valves and hydrants shall be operated to ensure disinfection of the appurtenances. At the end of the 24-hour period, the treated water in all portions of the main shall have a residual of not less than 10 mg/L free chlorine. Re-chlorinate if required results are not obtained on all samples.

h. After the applicable retention period, the heavily chlorinated water must not be disposed in a manner that will harm the environment. Neutralizing chemicals, such as Sulfur Dioxide, Sodium Bisulfite, Sodium Sulfite or Sodium Thiosulfate can be used to neutralize the chlorine residual remaining in the water to be wasted.

i. Flush all lines until residual is equal to existing system. After final flushing and before the water main is placed into service, water samples shall be collected from the main and tested for microbiological quality in accordance with the Georgia Rules for Safe Drinking Water, Chapter 391-3-5. The laboratory results must show the absence of coliform organisms in the water. Reflush and redisinfect the lines, as necessary, until satisfactory bacteriological results are obtained.

7.2.4.1 <u>DISINFECTION WHEN CUTTING INTO OR REPAIRING EXISTING MAINS</u>

a. Shall be performed when mains are wholly or partially dewatered;

b. Shall follow the current AWWA C651 Standards, including trench treatment, swabbing with hypochlorite solution, flushing and/or slug chlorination as appropriate;

c. Bacteriological testing shall be performed after the repairs are complete. However, depending upon the circumstances, the water main may be returned to service prior to completion of testing to minimize the time the customers are out of service.

d. Leaks or breaks that are repaired with clamping devices while the mains remain full of water under pressure may require no disinfection.

7.2.4.2 AMOUNT OF CHLORINE NECESSARY FOR DISINFECTION

a. Chlorine required to produce 25 mg/L concentration in 100 feet of pipe by diameter:

Pipe Diameter (inches)	100% Chlorine (lbs)	(g)	1% Chlorine Solution (gal)	(L)
4	0.013	5.9	0.16	0.6
6	0.030	13.6	0.36	1.4
8	0.054	24.5	0.65	2.5
10	0.085	38.6	1.02	3.9
12	0.120	54.4	1.44	5.4
16	0.217	98.4	2.60	9.8

Note: 1% chlorine solution may be prepared with sodium hypochlorite (contains 5% to 15% available chlorine) or calcium hypochlorite (contains approximately 65% available chlorine by weight). To prepare 1% chlorine solution using calcium hypochlorite, add one (1) pound (454 grams) of calcium hypochlorite in approximately 8 gallons of water.

b. Amounts and types of chemicals advised to be used for neutralizing various residual chlorine concentration in 100,000 gallons of water

Residual Chlorine Concentration	Chemicals							
	Sulfur Dioxide (SO_2)		Sodium Bisulfate ($NaHSO_3$)		Sodium Sulfite (Na_2SO_3)		Sodium Thiosulfate ($Na_2S_2O_3.5H_2O$)	
Mg/L	lb	Kg	lb	Kg	lb	Kg	lb	Kg
1	0.8	0.36	1.2	0.54	1.4	0.64	1.2	0.54
2	1.7	0.77	2.5	1.13	2.9	1.32	2.4	1.09
10	8.3	3.76	12.5	5.67	14.6	6.62	12.0	5.44
50	41.7	18.91	62.6	28.39	73.0	33.11	60.0	27.22

7.2.5 SEPARATION OF WATER MAINS AND SEWERS

7.2.5.1 GENERAL - The following factors should be considered in providing adequate separation:

a. materials and type of joints for water and sewer pipes;

b. soil conditions;

c. service and branch connections into the water main and sewer line;

d. compensating variations in the horizontal and vertical separations;

e. space for repair and alterations of water and sewer pipes;

f. off-setting of pipes around manholes;

g. water mains and sanitary or storm sewers shall not be laid in the same trench.

7.2.5.2 PARALLEL INSTALLATION

a. Water mains shall be laid at least ten (10) feet horizontally from any existing or proposed sanitary sewer, storm sewer or sewer manhole. The distance shall be measured edge-to-edge.

b. When local conditions prevent a horizontal separation of 10 feet, the water main may be laid closer to a sewer (on a case-by-case basis) provided the water main is laid in a separate trench or on an undisturbed earth shelf located on one side of the sewer at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer. It is advised that the sewer be constructed of materials and with joints that are equivalent to water main standards of construction and be pressure tested to assure water-tightness prior to backfilling.

7.2.5.3 CROSSINGS

a. Water mains crossing house sewers, storm sewers or sanitary sewers shall be laid to provide a separation of at least 18 inches between the bottom of the water main and the top of the sewer. At the crossings, one full length of water pipe shall be located so that both joints will be as far from the sewer as possible. Special structural support for the water and sewer pipes may be required.

b. When local conditions prevent a vertical separation of 18 inches, the sewer passing over or under water mains shall be constructed of materials and with joints that are equivalent to water main standards of construction and shall be pressure tested to assure water-tightness prior to backfilling.

c. When water mains cross under sewers, additional measures shall be taken by providing:

1. a vertical separation of at least 18 inches between the bottom of the sewer and the top of the water main;

2. adequate structural support for the sewers to prevent excessive deflection of joints and settling on and breaking the water mains;

3. that the length of water pipe be centered at the point of crossing so that the joints will be equidistant and as far as possible from the sewer; and,

4. both the sewer and the water main shall be constructed of water pipe materials and subjected to hydrostatic tests, as prescribed in this document. Encasement of the water pipe in concrete shall also be considered.

7.3.0 SURFACE WATER CROSSINGS

7.3.1 GENERAL: Surface water crossings, both over and under water, may present special concerns and should be discussed with the Division before the final plans are prepared.

a. At above water crossings, the pipe shall be adequately supported and anchored, protected from damage and freezing, and accessible for repairs or replacement.

b. At underwater crossings, a minimum of two (2) feet of cover shall be provided over the pipe.

c. The installation of ductile iron pipe with restrained push-on joints and encased in concrete, may be considered with the prior approval of the Division. Otherwise, when crossing water courses which are greater than 15 feet in width, only pipes of special construction, having flexible, watertight joints shall be installed.

d. Valves shall be provided at both ends of water crossings so that the section can be isolated for testing or repair (valves shall be easily accessible and not subject to flooding); the valve closest to the supply source shall be in a manhole;

e. Sampling taps shall be installed at each end of the crossing, and permanent taps shall be made for testing and determining leaks.

7.4.0 CROSS CONNECTIONS

7.4.1 GENERAL - There shall be no physical connection between the distribution system and any pipes, pumps, hydrants, or tanks whereby unsafe water and other contaminating materials may be discharged or drawn into the system.

a. The approval of the Division shall be obtained for interconnections between potable water supplies.

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

7.5.0 WATER SERVICES AND PLUMBING

a. Water services and plumbing should conform to relevant local and/or state plumbing codes, or to the Standard Plumbing Code, as applicable within the jurisdiction in which the system is located.

b. The product that is used for the service line must be listed as being certified for conformance with the NSF Standard 61.

c. All new services connected to community and nontransient noncommunity water systems shall be metered.

d. Any pipe, solder or flux used in the installation or repair shall be lead free with not more than 8.0% lead in pipes and fittings, and not more than 0.2% lead in solders or flux.

7.6.0 MATERIALS

7.6.1 GENERAL

a. All materials that come into contact with the drinking water during its treatment, storage, transmission or distribution shall not adversely affect drinking water quality and public health and must be certified for conformance with American National Standards Institute/ National Sanitation Foundation Standard 61 (ANSI/NSF Standard 61).

b. The pipe, fittings, valves and fire hydrants selected shall conform with the latest AWWA Standards. In the absence of such standards, pipe meeting applicable ASTM and ANSI criteria and acceptable to the Division may be selected.

c. Special attention shall be given to selecting pipe materials which will protect against both internal and external corrosion.

d. Used water mains that meet these standards may be used again after the pipe has been thoroughly cleaned and restored practically to its original condition.

e. Pipes and pipe fittings containing more than 8% lead shall not be used.

f. Pipe having mechanical joints or slip-on joints with rubber gaskets shall be used. Lead-tip gaskets shall not be used.

g. In general, packing and jointing materials used must meet the latest edition of the AWWA Standards. Joints shall conform to AWWA Standard C111.

h. Ductile iron and cast iron pipe shall meet the latest edition of ANSI/AWWA Standard C106 or C108 for cast iron pipe and C151 for ductile iron pipe.

i. Pipe and fittings shall be cement lined in accordance with the latest edition of AWWA Standard C104.

j. Fittings shall be ductile iron and shall conform to the latest edition of AWWA Standard C110 or C153.

k. Concrete pipe shall meet the latest edition of AWWA Standard C300.

7.6.2 PVC PIPE (2 inch through 12 inch)

a. PVC pipe meeting the standards set forth in AWWA C-900 (latest edition) shall be acceptable for those working pressures as designated by class. (Note that C-900 refers only to 4-inch through 12-inch pipe)

b. The pipe shall meet all the requirements set forth in ASTM Standard D 2241. The pipe must bear the seal of approval for potable water use and for conformance with NSF Standard 61.

c. Provisions must be made for contraction and expansion at each joint with flexible ring gaskets made from rubber or other suitable material. Gasket materials shall meet the requirements established in ASTM F477.

d. All fittings such as tees, ells, etc. using welded joints shall be factory welded and shall meet the same specifications as the welded bell section.

e. Lubricants shall be non-toxic, shall not promote biological growth, and shall be certified for conformance with NSF Standard 61.

f. Solvent cemented joints are not allowed for buried pipes.

g. Detection tape shall be placed along all PVC water mains.

7.6.3 OTHERS - Any pipe material which is not specifically stated in this section shall be considered on an individual basis.

7.6.4 VALVE, AIR RELIEF, METER AND BLOW-OFF CHAMBERS

a. Sediment accumulations may be removed through a standard fire hydrant. In addition, compressed air and pumping may be used for dewatering mains through hydrants.

b. 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 areas where flooding of the manhole or chamber may occur.

c. The open end of an air relief pipe from automatic valves shall be extended to at least one (1) foot above grade and provided with a screened, downward-facing elbow. The pipe from a manually operated valve should be extended to the top of the pit.

d. Chambers of pits 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.

e. 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.

f. Valves are to be placed at all intersections of water mains. Valves should be located at not more than 500 foot intervals in commercial districts and at not more than one block or 800 foot intervals in other districts. Where systems serve widely scattered customers, the valve spacing should not exceed 4000 feet.

g. Valves shall meet the current AWWA Standards.

PART 8 - FINISHED WATER STORAGE

8.1.0 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 American Water Works Association standards concerning steel tanks, standpipes, reservoirs, and elevated tanks wherever they are applicable. Other materials of construction may be acceptable when properly designed to meet the requirements of this part.

8.1.1 LOCATION

a. The bottom of ground-level reservoirs should be placed at the normal ground surface and above maximum flood level.

b. Where the bottom must be below normal ground surface, it should be placed above the ground water table.

c. Sewers, drains, standing water, and similar sources of contamination must be kept at least 50 feet from the reservoir. Mechanical-joint water pipe, pressure tested in place to 50 psi without leakage may be used for gravity sewers at lesser separations.

d. The top of a ground-level reservoir should not be less than 2 feet above normal ground surface and any possible flood level. Clearwells constructed under filters may be exempted from this requirement when the total design gives the same protection.

8.1.2 PROTECTION

a. All new finished water storage structures shall have suitable watertight roofs or covers which exclude birds, animals, insects, and excessive dust.

b. Protection from Trespassers: Fencing, locks on access manholes, and other necessary precautions shall be provided to prevent trespassing, vandalism and sabotage.

8.1.3 DRAINS - No drain on a water storage structure may have a direct connection to a sewer or storm drain. Splash pad and drainage channel shall be provided to prevent erosion. The outlet of the drain shall be provided with a twenty-four mesh non-corrodible screen or a flap valve.

8.1.4 OVERFLOW

a. The overflow pipe of a water storage structure shall be brought down near the ground surface and discharged over a drainage inlet structure or a splash plate and flow onto a drainage ditch which is rip-rapped or otherwise protected to minimize erosion.

b. No overflow shall be connected directly to a sewer or storm drain or be not visible to sight.

c. When an internal overflow pipe is used, it shall be located in the access tube.

d. The overflow of a ground-level structure shall be high enough above normal or graded ground surface to prevent the entrance of surface water.

e. The overflow shall be protected with a twenty-four mesh non-corrodible screen and/or a flap valve.

f. The outlet of the overflow shall always be visible.

8.1.5 ACCESS

a. Finished water storage structures shall be designed with reasonably convenient access to the interior for cleaning and maintenance.

b. Manholes on scuttles above waterline:

1. shall be framed at least 4 inches, and preferably 6 inches, above the surface of the roof at the opening. On ground-level structures, manholes should be elevated 24 to 36 inches above the top or covering sod;

2. shall be fitted with a solid watertight cover which overlaps the framed opening and extends down around the frame at least 2 inches;

3. should be hinged at one side;

4. shall have a locking device; and,

5. shall be a minimum of 20 inches in diameter or equivalent.

8.1.6 VENTS

a. Finished water storage structures shall be vented by separate special vent structures.

b. Overflow pipe or any other opening constructed between the side wall and the roof is not permissible to be used as vents.

c. The vents:

1. shall prevent the entrance of surface water;

2. shall exclude birds and animals;

3. shall exclude insects and dust, as much as this function can be made compatible with effective venting. For elevated tanks and standpipes, 4-mesh non-corrodible screen may be used;

4. shall, on ground-level structures, terminate in an inverted U construction, the opening of which is 24 to 36 inches above the roof of sod and is covered with 24-mesh non-corrodible screen.

8.1.7 <u>ROOF AND SIDEWALL</u> - The roof and sidewalls of all structures must be watertight with no openings except properly constructed vents, manholes, overflows, risers, drains, pump mountings, control ports or piping for inflow and outflow.

a. any pipe running through the roof or sidewall of a finished water storage structure must be welded or properly gasketed in metal tanks, or should be connected to standard wall castings which were poured in place during the forming of a concrete structure; these wall castings should have flanges embedded in the concrete.

b. 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 slope water to the structure.

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

8.1.8 <u>DRAINAGE FOR ROOF OR COVER</u> - The roof or cover of the storage structure should be well drained, but downspout pipes shall not enter or pass through the reservoir, parapets or similar construction which would tend to hold water and snow on the roof will not be approved.

8.1.9 <u>SAFETY</u> - The safety of employees must be considered in the design of the storage structure. As a minimum, such matters shall conform to pertinent laws and regulations.

a. ladders, ladder guards, balcony railings, and safe location of entrance hatches shall be provided where applicable;

b. elevated tanks with riser pipes over 8 inches in diameter shall have protective bars over the riser openings inside the tank.

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

8.1.11 GRADING - The area surrounding a ground-level structure shall be graded in a manner that will prevent surface water from standing within 50 feet of the structure.

8.1.12 SILT STOP - The discharge pipe of the reservoir shall be located in a manner that will prevent the flow of sediment into the distribution system. Either a permanent or removable silt stop shall be provided at least 4 inches above the bottom of the storage structure.

8.1.13 PAINTING AND/OR CATHODIC PROTECTION - Proper protection should be given to metal surfaces by paints or other protective coatings, by cathodic protective devices or by both.

a. Paint systems shall be consistent with the current American Water Works Association standards and all paint coatings must be certified for conformance with NSF Standard 61 for contact with potable water.

b. Cathodic protection should be designed and installed by competent technical personnel.

8.1.14 TURNOVER OF WATER – If the storage reservoir is sized larger than required for initial demand and there is more than 2 days storage, provisions shall be made for tumover of the water in the tank and/or booster chlorination.

8.1.15 SAMPLING - A suitable sampling tap should be provided on all storage structures and be protected from public access.

8.1.16 ADJACENT COMPARTMENTS - Finished water must not be stored or conveyed in a compartment adjacent to unsafe water when the two compartments are separated by a single wall.

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

8.2.0 DISINFECTION OF STORAGE TANKS

a. Finished water storage structures shall be disinfected in accordance with the latest edition of AWWA Standard C652 before being placed into or restored to service.

b. The forms of chlorine that may be used during disinfection are high-test calcium hypochlorite, sodium hypochlorite solution or liquid chlorine.

c. Only potable water shall be used as the water supply during the disinfecting operations.

d. One of the three following methods of disinfection shall be used:

1. First Method: After the storage tank has been thoroughly dried, it shall be filled slowly to the overflow level with potable water to which enough chlorine is added to provide a free chlorine residual in the full facility of not less than 10 mg/L at the end of the 24-hour period. After the 24-hour retention period, the highly chlorinated water in the storage tank shall be completely emptied (by applying a reducing agent to the wasted water to thoroughly neutralize the chlorine residual in the water), and then refilled with potable water. After refilling, samples of water shall be taken from the storage tank and tested to demonstrate that the water in the tank is microbiologically satisfactory in accordance with the Georgia Rules for Safe Drinking Water, Chapter 391-3-5, before the tank is placed in or restored to regular service.

2. Second Method: The walls and bottoms of storage tanks shall be thoroughly cleaned to remove all dirt and loose material. A strong chlorine solution (at least 200 mg/L) shall be applied to the surface of all parts of the storage facility, including the inlet and outlet piping, that would be in contact with water when the storage facility is full to the overflow elevation. The disinfected surfaces shall remain in contact with the strong chlorine solution for at least 30 minutes, after which potable water shall be admitted. After that, the highly chlorinated water in the tank shall be disposed in an acceptable manner, as stated above, and then refilled with potable water to its overflow level. After refilling, samples of water shall be taken from the storage tank and tested to demonstrate that the water in the tank is microbiologically satisfactory in accordance with the Georgia Rules for Safe Drinking Water, Chapter 391-3-5, before the tank is placed in or restored to regular service.

3. Third Method: Water containing a minimum of 50 mg/L chlorine shall be placed in the storage tank to such depth that, when the storage tank is filled with potable water to the overflow level and held full for a period of at least 24 hours, there will be a free chlorine residual of not be less than 2 mg/L. The full storage tank must be allowed to stand for 24 hours. All highly chlorinated water shall then be purged from the drain piping. Samples of water shall be taken from the storage tank and tested to demonstrate that the water in the tank is microbiologically satisfactory in accordance with the Georgia Rules for Safe Drinking Water, Chapter 391-3-5. The storage tank may be put into service without draining the remaining water in the tank.

8.3.0 OTHER STORAGE TANKS

8.3.1 PLANT STORAGE - The applicable design standards of this document shall be followed for the plant storage.

8.3.2 WASHWATER TANKS - If washwater tanks are used, they shall be sized in conjunction with available pump units and finished water storage to furnish the back wash water required. In the design, consideration must be given to the possibility of having to wash more than one filter at a time or several filters in succession.

8.3.3 CLEARWELL - Clearwell storage should be sized in conjunction with distribution system storage to relieve the filters from having to follow fluctuations in water use to meet peak demands, including filter backwash water.

a. The design shall include features (i.e. baffles) to minimize short circuiting.

b. It shall be sized to provide the required contact time for chlorine (CT), to achieve required level of inactivation of *Giardia* cysts and viruses (or any other pathogen that may be required under the current Surface Water Treatment Rules) through disinfection under worst case conditions.

c. A drain and an overflow shall be provided for the clearwell.

d. It shall be vented.

8.3.4 PRESSURE TANKS - Hydropneumatic (pressure) storage tanks should be located above normal ground surface and either be completely housed or one end be projected into an operating house to prevent freezing of the control units.

8.3.4.1 Bypass - Tanks should have bypass piping to permit operation of the system while the tank is being repaired or painted.

8.3.4.2 Paint systems shall be consistent with the current American Water Works Association Standards and all paint coatings must be certified for conformance with NSF Standard 61 for contact with potable water.

8.3.4.3 Disinfection - Finished water storage structures shall be disinfected in accordance with the latest edition of AWWA Standard C652 before being placed into service.

8.3.4.4 Sampling - A suitable sampling tap should be provided on all storage structures and be protected from public access.

8.3.4.5 Protection from Trespassers – Fencing and other necessary precautions shall be provided to prevent unauthorized entry, vandalism, and sabotage.

8.3.4.6 Appurtenances - Each tank should have an access manhole, cutoff valves, a drain, a control equipment consisting of pressure gage, water sight glass, automatic or manual air blow-off, mechanical means for adding air, and pressure-operated start-stop controls for the pumps.

8.3.4.7 Sizing - The hydropneumatic tanks must be properly sized to supply the required peak demand for a period of at least twenty (20) minutes. In the design, it is assumed that a combination of hydropneumatic storage and pumping will be utilized. The Effective Volume of the tank is considered to be the volume of water discharged between the high and low pressure settings.

Required Effective Volume (gal) = [Peak Demand (gpm) - Pumping Capacity (gpm)] x 20 minutes

For example, a mobile home system that serves 50 spaces will require an instantaneous (peak) demand flow of 60 gpm (see the tables provided in this document). If this system has a well with a pumping capacity of 30 gpm, then the required effective volume for the system is 600 gallons:

Required Effective Volume = (Peak Demand - Pumping Capacity) x 20 Minutes

= (60 gpm – 30 gpm) x 20 minutes

= 600 gallons

The actual size of the pressure storage tank necessary to furnish the 600 gallons effective volume depends upon the pressure settings, air-water volume controls, etc. A system without an air-water control system would require the largest tank, whereas a system with an air charging device and automatic air-water volume controls would require a much smaller tank. As indicated above, all pressure storage tanks must be equipped with mechanical means for adding air, and pressure-operated start-stop controls for the pumps. In general, it is assumed that a properly designed pressure tank with an air charging system with automatic air-water volume controls, would be able to discharge up to 25 % of the tank volume during a typical 60-40 psi pressure cycle. Then the total tank volume necessary to furnish the required effective volume in this case would be:

$$\text{Total Tank Volume (gallons)} = \frac{\text{Required Effective Volume (gallons)}}{25\%}$$

$$= \frac{\text{600 gallons}}{0.25}$$

$$= \text{2,400 gallons}$$

8.3.4.8 Auxiliary power – It is highly recommended that an auxiliary power with an automatic takeover capability be provided when positive pressures are not available from system gravity flow.

8.3.5 DISTRIBUTION STORAGE - The applicable design standards of this document shall be followed for distribution storage.

a. The purpose of system storage is to have sufficient water available to provide adequate flow and pressure at peak demand as well as to provide for fire flows when needed. For most water systems a satisfactory rule-of-thumb to meet these needs is to provide at least the average 24-hour demand in elevated storage. An engineering study should be performed to determine the system's actual elevated storage capacity needs.

b. Pressure Variation - System pressure variation on account of changes in level of water in storage structures should be minimized. Elevated storage tanks or large diameter ground tanks located on high ground should be the usual choices. Normally, standpipes should not be considered for distribution storages, unless completely justified.

c. Drainage - Storage structures which float on the distribution system should be designed to drain for cleaning or maintenance without necessitating loss of pressure in the distribution system. The drains should discharge to the ground surface with no direct connection to a sewer or storm drain. A nearby fire hydrant may be considered as a drain as long as service is not interrupted and suitable erosion protection is provided.

d. Level Controls - Adequate controls shall be provided to maintain levels in distribution system storage structures.

1. Telemeter equipment should be used when pressure-type controls are employed and any appreciable head loss occurs in the distribution system between the source and the storage structure.

2. Altitude valves or equivalent controls may be required for a second and subsequent structures on the system.

3. Overflow and low-level warnings or alarms should be located at places in the community where they could be under responsible surveillance on a 24 hour basis.

PART 9 - PUMPING FACILITIES

9.1.0 GENERAL

a. Pumping facilities shall be designed to maintain the sanitary quality of pumped water.

b. Subsurface pits or pump rooms and inaccessible installations should be avoided.

c. No pumping station shall be subject to flooding.

9.1.1 LOCATION - The pumping station shall be so located that the proposed site will meet the requirements of the sanitary protection of the water quality, hydraulics of the system and be protected against interruption of service by fire, flood or any other hazard.

a. The station shall be:

   1. elevated to a minimum of one foot above highest recorded flood elevation, or protected to such elevation;

   2. accessible at all times unless permitted to be out of service for period of inaccessibility;

   3. graded around station so as to divert surface drainage away from the station;

   4. protected to prevent vandalism and entrance by unauthorized persons or animals.

9.2.0 GROUND WATER FACILITIES - Where pumping facilities are used, wells and springs shall be vented by properly hooded and screened pipe extending at least 12 inches above the pump floor. Where necessary, provision shall be made for lubricating the pump from a point at least 6 inches above the top of the well cover by means which will prevent contamination of the water supply.

9.2.1 DRILLED WELLS - Pumping stations located over drilled wells shall:

a. have riser pipe or casing ex-tending at least 12 inches above the floor and be equipped with flange or suitable stuffing box;

b. have riser pipe or casing firmly connected to the pump structure to provide a water tight connection;

c. have base of pump not less than 6 inches above pump room floor;

d. have pump foundation and base designed to prevent water from coming into contact with the joint.

9.2.1.1 <u>SUBMERSIBLE PUMPS</u> - Where a submersible pump is used, the top of the casing shall be effectively sealed against entrance of water under all conditions of vibration or movements of conductors or cables.

9.2.1.2 <u>DISCHARGE PIPING</u> - Discharge piping should be provided with means to pump to waste but shall not be directly connected to a sewer. The discharge line shall:

a. have control valves located above pump floor;

b. be protected against freezing;

c. be valved to permit testing and control of each well;

d. have watertight joints;

e. have all exposed valves protected.

9.3.0 <u>SURFACE WATER FACILITIES</u> - Pump stations normally associated with surface water sources, either as raw or finished water pump stations shall:

a. have adequate space for the installation of additional units if needed. and for the safe servicing of all equipment;

b. be of durable character, fire and weather resistant and with outward opening doors;

c. have floor elevation of at least 6 inches above finished grade;

d. have underground structure waterproofed;

e. have all floors drained without impairing the quality of water being handled and if equipment is contained on the floor, the floor shall have sufficient slope to drain adequately;

f. provide suitable outlet for drainage from pump glands without discharging onto the floor.

9.3.1 SUCTION WELL - Suction wells shall:

a. be watertight;

b. have floors sloped to permit removal of water and entrained solids;

c. be covered or otherwise protected against contamination, including pump lubricant.

9.3.2 EQUIPMENT SERVICING - Pump facilities shall be provided with:

a. crane-ways, hoist beams, eye bolts or other adequate facilities for servicing or removal of pumps, meters or heavy equipment;

b. openings in floors, roofs or wherever else needed for removal of heavy or bulky equipment;

c. a convenient tool board or other facilities as needed for proper maintenance of the equipment.

9.3.3 STAIRWAYS AND LADDERS - Stairways or ladder shall:

a. be provided between all floors in pits or compartments which must be entered;

b. have handrails on both sides and treads of non-slip material.

c. Stairs are preferred in areas where there is frequent traffic or where supplies are transported by hand. They shall have risers not exceeding 9 inches and treads wide enough for safety.

9.3.4 HEATING - Provision shall be made for adequate heating for:

a. comfort of the operator;

b. the safe and efficient operation of the equipment;

c. In pump houses not occupied by personnel, only enough heat need be provided to prevent freezing of equipment or treatment process.

9.3.5 VENTILATION – Adequate ventilation shall be provided for all pumping stations. Forced ventilation of at least 6 changes of air per hour shall be provided for:

a. all rooms, compartments, pits and other enclosures below grade floor;

b. any area where unsafe atmosphere may develop or where excessive heat may be built up.

9.3.6 DEHUMIDIFICATION - In areas where excess moisture could cause hazards to safety or damage to equipment means for dehumidification shall be provided.

9.3.7 LIGHTING - Pump stations shall be adequately lighted throughout. All electrical work shall conform to the requirements of the related agencies and to relevant State and/or local codes.

9.3.8 SANITARY AND OTHER CONVENIENCES - Pumping stations which are manned for extended periods shall be provided with potable water, lavatory and toilet facilities. Plumbing must be so installed as to prevent contamination of a public water supply.

9.4.0 PUMPS

9.4.1 GENERAL

a. At least 2 pumping units shall be provided. Each pumping unit shall be capable of carrying the peak demand. If more than 2 units are installed, they shall have sufficient capacity so that any one pump can be taken out of service and the remaining pumps are capable of carrying the peak demand.

b. The pumping units shall:

1. have ample capacity to supply the peak demand without dangerous overloading;

2. be driven by a prime mover able to operate against the maximum head and air temperature which may be encountered;

3. have spare parts and tools readily available.

9.4.2 SUCTION LIFT - Suction lift pumps shall be considered on an individual basis based on justification of the design engineer.

9.4.3 BOOSTER PUMPS - Booster pumps shall be located or controlled so that:

a. they will not produce negative pressure anywhere in the distribution system.

b. the pressure in the suction line shall be maintained at or above 20 psi by the use of a pressure sustaining valve or low pressure cutoff device.

c. automatic or remote control devices shall have a range between the start and cutoff pressure which will prevent excessive cycling.

9.4.4 IN-LINE BOOSTER PUMPS - In addition to the other requirements of this section, in-line booster pumps shall be accessible for servicing and repairs.

9.4.5 FIRE PUMPS - The criteria in this section also apply to fire pumps.

9.5.0 AUTOMATIC AND REMOTE CONTROLLED STATIONS - All automatic stations shall be provided with automatic signaling apparatus which 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 acceptable and applicable codes.

9.6.0 APPURTENANCES

9.6.1 VALVES

a. 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 ½times the area of the suction pipe and they shall be screened.

b. Each pump shall have a positive acting check valve on the discharge side between the pump and shutoff valve.

9.6.2 PIPING – In general, piping shall:

a. be designed so that friction head will be minimized;

b. not be subject to contamination;

c. have watertight joints;

d. be protected against surge or water hammer;

e. be such that each pump has an individual suction line or the lines shall be so manifolded that they will insure hydraulic and operation conditions.

9.6.3 GAUGES AND METERS – Each pump shall:

a. have a standard pressure gauge on its discharge line;

b. have a compound gauge on its suction line;

c. have recording gauges in larger stations;

d. have a means for measuring the discharge;

e. have sampling taps;

f. Large stations should be equipped with totalizing and recording metering of the total water pumped.

9.6.4 WATER SEALS – Water seals shall not be supplied with water of a lesser sanitary quality than that of the water being pumped.

9.6.5 CONTROLS – Pumps, their prime movers and accessories, shall be controlled in such a manner that they will operate at rated capacity without dangerous overload. Where two or more pumps are installed, provision shall be made for proper alternation. Provision shall be made to prevent operation of the pump during the backspin cycle. Electrical controls shall be located above grade.

9.6.6 POWER – When power failure would result in cessation of minimum essential service, power supply shall be provided from at least two independent sources or standby or auxiliary source shall be provided or be available.

9.6.7 AUXILIARY POWER SUPPLY – When automatic pre-lubrication of pump bearings is necessary, and an auxiliary power supply is provided, then the pre-lubrication line shall be provided with a valved by-pass around the automatic control.

PART 10 - TREATMENT

10.1.0 GENERAL

a. The design of treatment processes and devices depends on evaluation of the nature and quality of the particular water to be treated and the desired quality of the finished water. However, the constructed facilities and the quality of the finished water must consistently and reliably meet the applicable state and federal drinking water standards.

b. All those water systems that are using surface water sources or ground waters determined to be under the direct influence of surface waters shall be designed and constructed to assure compliance of the finished water quality with the current state and federal regulations that are in effect concerning the treatment, removal, and inactivation of the applicable chemical, physical and biological contaminants.

c. The quality of the raw water, the quality desired in the finished water and other factors may require installation of multiple-stage treatment facilities and/or presedimentation facilities.

d. Water treatment plants processing surface water sources shall include, but not limited to, means for rapid mixing, flocculation, sedimentation, filtration and disinfection. They shall preferably be of conventional type design.

   1. Pressure filtration systems shall not be installed to treat surface water supply sources.

   2. The treatment plant shall be of such construction to allow units to be taken out of service without disrupting the operation and required treatment processes.

e. At its discretion, the Division may accept new and alternate treatment means, methods and technologies, provided the following are demonstrated to the satisfaction of the Division:

   1. The treatment method has been thoroughly tested in full scale comparable installations by an acceptable third party, in accordance with protocol and standards acceptable to the Division; and

   2. Has been thoroughly tested in a plant approved by the Division, by an acceptable third party, in accordance with protocol and standards acceptable to the Division, and operated for a period that shall demonstrate the effectiveness and reliability of the proposed treatment system during changes in seasonal and climatic conditions.

10.2.0 CLARIFICATION – Plants designed for processing surface waters should:

1. provide a minimum of two units each for flocculation and sedimentation;

2. 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;

3. be constructed to permit units to be taken out of service without disrupting operation, and with drains or pumps sized to allow dewatering in a reasonable period of time;

4. provide multiple-stage treatment facilities when required by the Division;

5. be started manually following shutdown;

6. minimize hydraulic head losses between units to allow future changes in processes without the need for repumping.

10.2.1 PRESEDIMENTATION - Waters containing high turbidity may require pretreatment, usually sedimentation either with or without the addition of coagulation chemicals.

1. Basin design – Presedimentation basins should have hopper bottoms or be equipped with continuous mechanical sludge removal apparatus, and provide arrangements for dewatering. Ponds used for presedimentation should be designed to hold maximum 3-day usage.

2. Inlet – Incoming water shall be dispersed across the full width of the line of travel as quickly as possible; short-circuiting must be prevented.

3. Bypass – Provisions for bypassing presedimentation basins shall be included.

4. Detention Time – Three (3) hours detention is the minimum period recommended. Greater detention may be necessary and is preferred.

10.2.2 RAPID MIX - Rapid mix shall mean 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 and water temperature, color and other related water quality parameters. The velocity gradient should not be less than 300 (ft/sec)/ft.

1. Equipment – Basins should be equipped with mechanical mixing devices; other arrangements, such as baffling, in-line mixers may be acceptable.

2. Mixing – The detention period should be not more than thirty (30) seconds.

3. Location – The rapid mix and flocculation basin shall be as close together as possible.

4. SCD – Install a streaming current detector for continuous monitoring of coagulant dosage to assist in optimizing the coagulation process.

10.2.3 FLOCCULATION - Flocculation shall mean the agitation of water at low velocities for long periods of time.

1. Basin Design – Inlet and outlet design shall prevent short-circuiting and destruction of floc. A drain and/or pumps shall be provided to handle dewatering and sludge removal.

2. Detention – The flow-through velocity shall be not less than 0.5 nor greater than 1.5 feet per minute with a detention time for floc formation of at least 30 minutes.

3. Equipment – Agitators shall be driven by variable speed drives with the peripheral speed of paddles ranging from 0.5 to 3.0 feet per second. The speed of each successive agitator should be less than the previous one.

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 must be made to minimize turbulence at bends and changes in direction.

5. Other Designs – Baffling may be used to provide for flocculation in small plants only after consultation with the Division. The design should be such that the flow-through velocity shall be not less than 0.5 nor greater than 1.5 feet per minute with a detention time for floc formation of at least 30 minutes as noted above.

10.2.4 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.

a. The plant shall have a minimum of two (2) basins.

b. Under optimal operation conditions, the design must allow the operator to be able to achieve a settled water turbidity of not more than 1 NTU prior to the filtration.

c. The following criteria apply to sedimentation units:

    1. Even Flow – Flow shall be evenly distributed to each basin from the flocculation chamber(s).

2. Detention Time – Shall provide a minimum of four (4) hours of settling time. This may be reduced to two hours for lime-soda softening facilities treating only groundwater. Dependent upon the basin design and raw water quality, reduced sedimentation time may also be approved when equivalent effective settling is demonstrated (i.e. plate settlers); however, provisions should be made for more frequent removal of sludge from the basins than is required for conventional sedimentation.

3. Ratio – Rectangular basins shall have a length to width ratio of 4:1 with an average depth of 8 feet. However, calculations using surface area, overflow rate and detention time should be used to determine the depth.

4. 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 should 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. This velocity should not exceed 0.25 ft/sec.

5. 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.

6. Overflow Rate – The rate of flow over the outlet weir shall not exceed 20,000 gallons per day per foot of weir length. The overflow weir should be installed which will establish the maximum water level desired on top of the filters. They shall not be flooded. Adjustable V-notch weirs are preferred. 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.

7. Velocity – The velocity through settling basins shall not exceed 0.5 feet per minute. The basins must be designed to minimize short-circuiting. Fixed or adjustable baffles must be provided as necessary to achieve the maximum potential for clarification. Not applicable if tube or plate settlers are used.

8. Overflow – An overflow weir (or pipe) should be installed which 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.

9. Sludge Collection – Mechanical sludge collection equipment should be provided.

10. Drainage – Basins must be provided with a means for dewatering. Basin bottoms should slope toward the drain not less than one foot in twelve feet where mechanical sludge collection equipment is not required.

11. Flushing Lines – Flushing lines or hydrants shall be provided and must be equipped with backflow prevention devices acceptable to the Division.

12. Safety – Permanent ladders or handholds should be provided on the inside walls of basins above the water level. Guard rails should be included.

13. Sludge Removal – Sludge removal design shall provide that:

    (A) sludge pipes shall be not less than three inches in diameter and so arranged as to facilitate cleaning;

    (B) entrance to sludge withdrawal piping shall prevent clogging;

    (C) valves shall be located outside the tank for accessibility;

    (D) the operator may observe and sample sludge being withdrawn from the unit.

14. Sludge Disposal – must be accomplished in accordance with the applicable rules in effect.

10.2.5 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, the Division should be contacted before the design has started. Clarifiers should be designed for the maximum uniform rate and should be adjustable to changes in flow which are less than the design rate and for changes in water characteristics. A minimum of two (2) units are required for surface water treatment. The following are design criteria for consideration, but any design shall be submitted in detail to be reviewed on a case-by-case basis.

a. Installation of Equipment – Supervision by a representative of the manufacturer shall be provided with regard to all mechanical equipment at the time of:

    1. installation; and

    2. initial operation.

b. Operating Equipment – The following shall be provided for plant operation:

    1. a complete outfit of tools and accessories;

    2. necessary laboratory equipment;

3. adequate piping with suitable sampling taps so located as to permit the collection of samples of water from critical portions of the units.

c. Chemical Feed – Chemicals shall be applied at such points and by such means as to insure satisfactory mixing of the chemicals with the water.

d. Mixing – A rapid mix device or chamber ahead of solids contact units may be necessary to assure proper mixing of the chemicals applied. Mixing devices employed shall be so constructed as to:

1. provide good mixing of the raw water with previously formed sludge particles; and

2. prevent deposition of solids in the mixing zone.

e. Flocculation - Flocculation equipment:

1. shall be adjustable (speed and/or pitch);

2. must provide for coagulation in a separate chamber or baffled zone within the unit;

3. should provide the flocculation and mixing period to be not less than 30 minutes.

f. 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.

g. Sludge Removal - Sludge removal design shall provide that:

1. sludge pipes shall be not less than three (3) inches in diameter and so arranged as to facilitate cleaning;

2. entrance to sludge withdrawal piping shall prevent clogging;

3. valves shall be located outside the tank for accessibility;

4. operator may observe and sample sludge being withdrawn from the unit; and

5. backflow from sanitary sewer systems be impossible.

h. Cross-Connections

1. Blow-off outlets and drains must terminate and discharge at places satisfactory to the Division.

2. Cross-connection control must be included for the potable water lines used to backflush sludge lines.

i. Detention Period – The detention time shall be established on the basis of the raw water characteristics and other local conditions that affect the operation of the unit. Based on design flow rates, the detention time should be:

1. two to four hours for suspended solids contact clarifiers and softeners treating surface water; and

2. one to two hours for the suspended solids contact softeners treating only ground water.

j. Suspended Slurry Concentrate - Softening units should be designed so that continuous slurry concentrates of one percent or more, by weight, can be satisfactorily maintained.

k. Water Losses - Units shall be provided with suitable controls for sludge withdrawal.

1. Total water losses should not exceed five percent (5%) for clarifiers, and three percent (3%) for softening units.

2. Solids concentration of sludge bled to waste should be three percent (3%) by weight for clarifiers, and five percent (5%) by weight for softeners.

l. 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 over 10 feet horizontally to the collection trough. Weirs shall be:

1. Adjustable, and at least equivalent in length to the perimeter of the tank;

2. Weir loading shall not exceed:

(A) 10 gallons per minute per foot of weir length for units used for clarifiers;

(B) 20 gallons per minute per foot of weir length for units used for softeners;

(C) Where orifices are used, the loading rates per foot of launder rates should be equivalent to weir loadings. Either shall produce uniform rising rates over the entire area of the tank.

m. Upflow Rates - Unless supporting data is submitted to the Division to justify rates exceeding the following, rates shall not exceed:

1. 1.0 gallon per minute per square foot of area at the sludge separation line for units used for clarifiers,

2. 1.75 gallons per minute per square foot of area at the slurry separation line for units used for softeners.

10.2.6 TUBE OR PLATE SETTLERS - Proposals for settler unit clarification must include pilot plant and/or full scale demonstration satisfactory to the Division prior to the preparation of final plans and specifications for approval. Settler units consisting of variously shaped tubes or plates which are installed in multiple layers and at an angle to the flow may be used for sedimentation, following flocculation.

10.2.6.1 GENERAL CRITERIA

a. Inlet and Outlet Considerations - Design to maintain velocities suitable for settling in the basin and to minimize short-circuiting.

b. Drainage - Drain piping from the settler units must be sized to facilitate a quick flush of the settler units and to prevent flooding other portions of the plant.

c. Protection from Freezing - Although most units will be located within a plant, outdoor installations must provide sufficient freeboard above the top of settlers to prevent freezing in the units.

d. Application Rate - A maximum rate of 2 gal/ft^2/min of cross-sectional area (based on 24-inch long 60 degree tubes or 39.5-inch long 7 ½degree tubes), unless higher rates are successfully shown through pilot plant or in-plant demonstration studies.

e. Flushing Lines - Flushing lines shall be provided to facilitate maintenance and must be properly protected against backflow or back siphonage.

10.3.0 FILTRATION

10.3.1 GENERAL - Acceptable filters shall be upon the discretion of the Division. The application of any one type must be supported by water quality data representing a reasonable period of time to characterize the variations in water quality. Experimental (pilot) treatment studies may be required to demonstrate the applicability of the method of filtration proposed. Filtration rates greater than 5 gpm/ft^2 are not recommended and may not be approved. All filters shall have provisions for filtering to waste. The design of the filter must allow the water operator to achieve a filtered water effluent of 0.1 NTU or less at each filter under optimal operating conditions.

10.3.2 RAPID RATE GRAVITY FILTERS:

a. Pretreatment - The use of rapid rate gravity filters shall require pretreatment.

b. Number - At least two (2) units shall be provided. Where only two 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 filter units are provided, the filters shall be capable of meeting the plant design capacity at the approved filtration rate with one filter removed from service. Where declining rate filtration is provided, the variable aspect of filtration rates, and the number of filters must be considered when determining the design capacity for the filters.

c. Rate of Filtration - The permissible 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 operating personnel and other factors as required by the Division. The normal rate shall be 2 gpm/ft^2, and should not exceed 5 gpm/ft^2 of filter area, for turbidity removal plants.

d. High Rate Filtration - Filtration rates for turbidity or iron removal plants of up to 4 gpm/ft are acceptable with the following:

1. Mixing flocculation, and sedimentation must meet the requirements of this document.

2. Dual or mixed filter media must be used. Mixed filter media configuration is preferred.

3. Full compliance with the current Surface Water Treatment Rules must be assured.

4. Additional instrumentation and monitoring devices may be required for those plants with filter rates greater than 2 gpm/ft^2.

5. Any proposal to operate a conventional plant with a filtration rate greater than 4 gpm/ft^2 shall require performance of a high-rate pilot study, in accordance with the protocols acceptable to the Division. Filtration rates greater than 5 gpm/ft^2 may be considered on a case by case basis, but generally rates greater than 5 gpm/ft^2 are not recommended for surface water sources and may not be approved. Unconventional or package type water treatment plants using surface water sources shall not operate at filtration rates greater than 5 gpm/ft^2.

6. Information listed below under the “high-rate guidelines” must be submitted to the Division for review and approval.

GUIDELINES FOR HIGH-RATE CONSIDERATION FOR FILTER RATES BETWEEN 2 AND 4 GPM/FT^2

Prior to the Division's approval of increased filter rates between 2 and 4 gpm/ft^2, the following items must be addressed and submitted for review and approval:

(A) A demand for the extra water must be documented by indicating current water usage, unaccounted for water, water conservation guidelines, accurate population projections, and future water demands;

(B) Complete and submit the “**Information and Data Submittal Form”**;

(C) Turbidity and/or particle count data on the raw or filter influent water and/or filtered effluent water should be available for EPD inspection (for existing plants, at least one year of data should be available);

(D) The results of a simulated CT study at the proposed flow conditions must be provided. Please be reminded the required log inactivation *of Giardia* cysts must be achieved at the proposed plant flow capacity;

(E) Baffling of the clearwell and sedimentation basin is required. Installation of plate or tube settlers in the sedimentation basin is preferred.

(F) An application to increase the water withdrawal permit must be submitted to the Division’s Water Resources Program.

(G) Plans and specifications for any necessary modifications to the treatment plant must be submitted for review and approval.

(H) After the above items have been submitted and concurred with, the Division may reduce or waive the requirement for an in-depth pilot study based on the submitted information and an onsite plant evaluation. A completed "Application to Operate a Public Water System” will be required in order to increase plant rates.

INFORMATION AND DATA SUBMITTAL FORM

GENERAL INFORMATION

Name of Facility:________________________________ WSID No:____________________

County:____

Permitted Flow Rate:_____________ MGD Proposed Flow Rate:_____________MGD

Permitted Filter Rate:_____________gpm/ft^2 Proposed Filter Rate:__________gpm/ft^2

Raw Water Turbidity: Year Max. _________NTU Year Avg. _____________NTU
Year Min._________NTU

Water Plant Operator(s):___________________________ Certification Level:_____________

___________________________ Certification Level:_____________

___________________________ Certification Level:_____________

___________________________ Certification Level:_____________

PLANT INFORMATION

Instrumentation

Raw Water Turbidimeter: Online____Grab___ Streaming Current Monitor: Yes____ No____

Particle Counter(s): Yes____ No_____ Influent sensor(s) location:________________________
Effluent sensor(s) location:________________________

Chemical Addition

Pre-Chemicals (Cl_2, alum, polymer, etc.):____

Taste and Odor Control:____

Iron and Manganese Removal:____

Flocculation Number of Flocculators:_______________________

Type of Flocculators (baffles, mechanical, plates, etc.):_______________________________

Mechanical Flocculator Stages: _______ (If applicable); Functional:__________Yes/No

Theoretical Detention Time:_____________Minutes (at current capacity)

Theoretical Detention Time:_____________Minutes (at proposed capacity)

Sedimentation Basins **Number of Basins:**__________________

Baffles in Sedirnentation basin(s): Yes____ No____ Plate or Tube Settlers:Yes___ No____

Weir Overflow Rate:_______________________ gpd/foot of weir length (at current capacity).

Weir Overflow Rate:______________________gpd/foot of weir length (at proposed capacity)

Theoretical Basin Detention Time:____________Minutes (at current capacity)

Theoretical Basin Detention Time:____________Minutes (at proposed capacity)

Filters:____________________ **Number of Filters:______________**

Filter Media Configuration:

Type: Single:______________ Dual:______________ Multi / Mixed:_________________

Other:____

Size and Depth of Media: Layer# I (Top):_______________________________________

Layer #2 (Middle or Bottom):_____________________________

Layer #3 (Bottom- if applicable):_________________________

Support Layer:_______________________________________

Date Verified:________________________Backwash Flow Rate:________________gpm/ft2

Filter Sweeps: Yes_____ No______ type:_________Air Scour: Yes_____ No_____

Finished Water Turbidimeter(s): Online_____ Grab_____ Sensor(s) location:______________

BACKWASH/ SLUDGE HANDLING

Describe Sludge Handling/Removal Facilities:____

____

LABORATORY EQUIPMENT

List all daily (raw, treated, finished) water parameter's tested:____________________________

Jar Test Equipment: Yes____ No___

Microbiological Test Equipment: Yes____ No____ Certified: Yes____ No____

Note: Attach additional pages if necessary.

HIGH-RATE PILOT STUDY GUIDELINES FOR FILTER RATES ABOVE 4 GPM/FT^2

In order to be approved to perform a high-rate pilot study, at filter rates above 4 gpm/ft^2 on treatments plants a detailed plant evaluation and a high-rate study plan which addresses the items listed in this sections must be submitted by a Registered Professional Engineer in the State of Georgia for review and concurrence.

(A) A demand for the extra water must be documented by indicating current water usage, unaccounted for water, water conservation guidelines, accurate population projections, and future water demands;

(B) A complete engineering evaluation, by a professional engineer licensed in the State of Georgia, of the existing facilities and unit process components, the proposed high-rate study plan, as well as the pertinent schematic drawings indicating the proposed flow rates through the unit processes. The evaluation must address the current treatment train and processes which includes flow rates, chemical addition points, sample points, weir overflow rates, simulated CT study, filter media configurations, plant storage, backwash water rates, sludge handling and pumps;

(C) Verification of the availability of additional raw water must be provided. Please contact the Water Resources Management Program of the Division for water withdrawal requirements;

(D) When required by the Division, turbidity and/or particle count data on the raw, settled or filter influent water and/or filtered effluent water for a duration of one year and;

(E) An unconventional or package type water treatment plant using surface water with a proposed filtration rate 5 gpm/ft^2 will be required to have a Certified Class I Water Plant Operator in responsible charge while the plant is in operation.

(F) After concurrence of the plant evaluation and the high-rate study plan (a through e above), the high-rate pilot study shall be conducted as follows:

1) The study must be conducted a minimum of 180 days, covering at least two seasons, including a period of cold weather;

2) The performance and results must be conducted under the supervision of a professional engineer licensed in the State of Georgia;

3) At least two (2) daily (or one per shift) coliform bacteria or standard plate count analysis of the filtered water from the pilot test filter(s) and the non-test filter(s) shall be performed by a Division approved laboratory and tabulated for comparison. Water sample taps shall be available on the effluent line from each filter;

4) In addition to the turbidity measurements required for normal plant operations, turbidity measurements of the raw water must be made at least once (1) a shift and settled water [goal is 1. 0 NTU or less] and the pilot test filter(s) and non-test filter(s) effluents [goal is 0.1 NTU or less] must be made and recorded at least at two (2) hour intervals while the plant is in operation. During the study, the combined filter effluent should not exceed 0.3 NTU.

5) Any failure to comply with the current Drinking Water Standards during the pilot test period and/or if the combined filter effluent at the plant reaches or exceeds 1.0 NTU, the study must be terminated.

6) Tests shall be performed during the pilot study to determine the actual detention time in the pilot test sedimentation basin(s) along with an evaluation of short-circuiting and weir loading rates;

7) During the pilot study of the higher filtration rate, calculate and record the daily theoretical CT value, but report the lowest daily CT value calculated during each month and the corresponding log inactivation for *Giardia;*

8) With a particle counting device, record and report the number (particles/ml of particles in the test and non-test filter(s) effluents at two (2) hour intervals, while the plant is in operation, in the size range between 3 and 15 microns;

9) Tests shall be performed every month for Total Organic Carbon (TOC) concentration from the effluent of the pilot test filter(s) and non-test filter(s) for comparison, prior to the point of continuous disinfectant application;

10) Simulated Distribution System (SDS) samples shall be collected every quarter from the effluent of the pilot test filter(s) and non-test filter(s) for total trihalomethanes (TTHMs) and total haloacetic acids (THAAs) analysis, to be performed by a private laboratory. The collected samples should be stored in a dark place and incubated at the same temperature and pH typically found in the distribution system for a reaction time comparable to the maximum detention time in the distribution system.

11) At the completion of the pilot study, the results from the above items along with any other pertinent findings (as well as recommendation) must be tabulated and submitted in a report form by the professional engineer.

12) Some plant design features may require additional evaluation or additional treatment studies (i.e. polymer and/or ferric chloride feed, enhanced coagulation, GAC, plate settlers, pre-settling units, deeper filter media configurations, or pilot plants) and/or a longer pilot study.

(G) Upon completion of a successful pilot study, the following minimum improvements must be completed at the water plant prior to the final approval and modification of the system's operating permit:

1) Based upon the results, submit engineering design plans and specifications for the necessary plant modifications, for Division's review and approval;

2) For filtration rates exceeding 4 gpm/ft^2 mixed media or deep-bed dual-media, with an acceptable agitation system, must be provided in all filters;

3) The system must currently be in compliance with the Federal Surface Water Treatment Regulations (SWTR), as adopted by Georgia;

4) Provisions to filtering to waste after a filter backwash cycle;

5) Provisions for continuous sludge removal in each sedimentation basin;

6) Adequate settled solids facilities to treat basin sludge and backwash water;

7) The operator in responsible charge of the water plant must be Class I Certified;

8) Modification of the Surface Water or Groundwater Withdrawal Permit;

9) Assurances that adequate wastewater treatment facilities will be available to treat the additional wastewater generated by the increased water plant capacity and;

10) Additional improvements identified during the pilot study or as deemed necessary by the Division, may be required.

10.3.3 FILTER STRUCTURAL DETAILS AND HYDRAULICS - The filter structure shall be designed to provide for:

a. vertical walls within the filter;

b. no protrusion of the filter walls into the filter media;

c. cover by superstructure as determined necessary under local climate;

d. head room to permit normal inspection and operation;

e. minimum depth of filter box of 8-1/2 feet;

f. minimum water depth over the surface of the filter media of three (3) feet;

g. trapped effluent to prevent backflow of air to the bottom of the filters;

h. prevention of floor drainage to the filter with a minimum 4-inch curb around the filters;

i. prevention of flooding by providing overflow;

j. maximum velocity of treated water in pipe and conduits to filters of two feet per second;

k. cleanouts and straight alignment for influent pipes or conduits where solids loading is heavy, or following lime-soda softening;

l. washwater drain capacity to carry maximum flow;

m. walkways around filters, to be not less than 24 inches wide;

n. safety handrails or walls around filter areas adjacent to normal walkways;

o. construction to prevent cross connections and common walls between potable and non-potable water.

10.3.4 WASHWATER TROUGHS - Washwater troughs should be constructed to have:

a. the bottom elevation above the maximum level of expanded media during washing;

b. a two-inch freeboard at the maximum rate of wash; At minimum, the troughs should be sized to accommodate backwash flow rates of 20 gpm/ft^2 without flooding.

c. the top edge level and all at the same elevation;

d. spacing so that each trough serves the same number of square feet of filter area;

e. maximum horizontal travel of suspended particles to reach the trough not to exceed three (3) feet.

10.3.5 FILTER MATERIAL – Installation of media shall be in accordance with the current AWWA Standards.

10.3.5.1 SAND - The media shall be clean silica sand, having the following characteristics:

a. a total depth of not less than 24 inches and generally not more than 30 inches;

b. an effective size range of the smallest material no greater than 0.45 mm to 0.55 mm;

c. a uniformity coefficient of the smallest material not greater than 1.65;

d. a minimum of 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 (i.e. anthracite) within the filter.

10.3.5.2 ANTHRACITE – A combination of clean crushed anthracite and sand can be used. The anthracite shall have:

a. an effective size of 0.8 mm - 1.2 mm;

b. a uniformity coefficient not greater than 1.85;

c. a hardness of 2.7 – 3 (MOH Scale)

d. anthracite layer shall not exceed 20 inches in a 30-inch bed.

10.3.5.3 MIXED MEDIA - To be approved by the Division.

10.3.5.4 TORPEDO SAND - A three-inch layer of torpedo sand should be used as a supporting media for filter sand, and should have:

a. effective size of 0.8 mm to 2.0 mm; and

b. uniformity coefficient not greater than 1.7.

10.3.5.5 GRANULAR ACTIVATED CARBON (GAC) - Granular activated carbon media may be considered only after pilot or full scale testing and with prior approval of the Division. The design shall include the following:

a. The media must meet the basic specifications for filter media as given in this document except that larger size media may be allowed by the Division where full scale tests have demonstrated that treatment goals can be met under all conditions.

b. There must be provisions for a free chlorine residual and adequate contact time in the water following the filters and prior to distribution.

c. There must be means for periodic treatment of filter material for control of bacterial and other growth.

d. Provisions must be made for frequent replacement or regeneration if GAC is used for filtration.

10.3.5.6 OTHER MEDIA - Other media may be considered based on experimental data and operating experience.

10.3.5.7 GRAVEL - Gravel, when used as the supporting media shall consist of hard, durable, rounded silica particles and shall not include flat or elongated particles.

a. The coarsest gravel shall be 2 ½ inches in size when the gravel rests directly on the strainer system, and must extend above the top of the perforated laterals.

b. Not less than four layers of gravel shall be provided in accordance with the following size and depth distribution when used with perforated laterals:

Size	Depth
2 1/2 to 1 1/2 inches	5 to 8 inches
1 1/2 to 3/4 inches	3 to 5 inches
3/4 to 1/2 inches	3 to 5 inches
1/2 to 3/16 inches	2 to 3 inches
3/16 to 3/32 inches	2 to 3 inches

c. Reduction of gravel depths may be considered upon justification when proprietary filter bottoms are specified.

d. The depth of any gravel layer should not be less than 2 inches or less than twice the largest gravel size for that layer, whichever is greater. The bottom layer should be thick enough to cover underdrain laterals, strainers, or other irregularities in the filter bottom. The total depth of gravel above the underdrains should not be less than ten (10) inches.

10.3.6 FILTER BOTTOMS AND STRAINER SYSTEMS - Departures from these standards may be acceptable for high rate filters and for proprietary bottoms. Porous plate bottoms shall not be used. The design of manifold-type collection systems shall be such as to:

a. minimize loss of head in the manifold and laterals;

b. assure even distribution of washwater and even rate of filtration over the entire area of the filter;

c. provide the ratio of the area of the final openings of the strainer systems to the area of the filter at about 0.003;

d. provide the total cross-sectional area of the laterals at about twice the total area of the final openings;

e. provide the cross-sectional area of the manifold at 1-1/2 to 2 times the total area of the laterals.

10.3.7 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 to insure maximum agitation over the entire filter area and include:

a. provision for water pressures of at least 45 psi; Higher pressures of 65-100 psi may be necessary for the proper operation of the revolving-type surface wash apparatus depending upon the diameter of the arms.

b. arms of the revolving-type surface wash apparatus should be placed about 2 inches above the surface of the unexpanded filter media;

c. a properly installed vacuum breaker or other approved device (i.e. double check valve or reduced pressure zone backflow preventer) to prevent back siphonage if connected to the treated water system;

d. rate of flow of 2.0 gpm/ft^2 of filter area with fixed nozzles or 0.5 gpm/ft^2 with revolving arms.

10.3.7.1 AIR SCOURING - Air scouring can be considered in place of surface wash.

a. air flow for air scouring the filter must be 3-5 standard cubic feet per minute per square foot of filter area when the air is introduced in the underdrain; a lower air rate must be used when the air scour distribution system is placed above the underdrains;

b. a method for avoiding excessive loss of the filter media during backwashing must be provided;

c. air scouring must be followed by a fluidization wash sufficient to restratify the media;

d. air must be free from contamination;

e. 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;

f. piping for the air distrubtion system shall not be flexible hose which will collapse when not under air pressure and shall not be a relatively soft material which may erode at the orifice opening with the passage of air at high velocity;

g. air delivery piping shall not pass down through the filter media nor shall there be any arrangement in the filter design which would allow short circuiting between the applied unfiltered water and the filtered water;

h. consideration should be given to maintenanace and replacement of air deliver piping;

i. the backwash delivery system must be capable of 15 gallons per minute per square foot of filter surface area; however, when air scour is provided the backwash rate must be variable and should not exceed 8 gallons per minute per square foot unless operating experience shows that a higher rate is necessary to remove scoured particles from filter surfaces;

j. the filter underdrains shall be designed to accommodate air scour piping when the piping is installed in the underdrain; and

k. the provisions for backwash, as stated below, shall be followed.

10.3.8 <u>APPURTENANCES</u> - The following shall be provided for every filter:

a. influent and effluent sampling taps;

b. an indicating loss of head gauge;

c. an indicating rate-of flow control. A modified rate controller which limits the rate of filtration to a maximum rate may be used. However, equipment that simply maintains a constant water level on the filters is not acceptable, unless the rate of flow onto the filter is properly controlled.

d. a turbidimeter with continuous turbidity reading in NTUs and a recorder;

e. a sensor on the effluent pipe connected to an online continuous particle counting device (and data processing system) for counting particles in a size range between 3 and 15 microns;

f. wall sleeves providing access to the filter interior at several locations for sampling or pressure sensing;

g. a 1 to 1-1/2 inch pressure hose and storage rack at the operating floor for washing filter walls. The hose connection shall be protected with a vacuum breaker;

h. provisions for filtering to waste with appropriate measures for backflow prevention.

10.3.9 <u>BACKWASH</u> - Provisions shall be made for washing filters as follows:

a. a minimum rate of 15 gallons per minute per square foot, consistent with water temperatures and specific gravity of the filter media. A rate of 20 gallons per minute per square foot or a rate necessary to provide for a 50 percent expansion of the filter bed is recommended. A reduced rate of 10 gallons per minute per square foot may be acceptable for full depth anthracite or granular activated carbon filters;

b. filtered water provided at the required rate by washwater tanks, a washwater pump, from the high service main, or a combination of these;

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

d. water supply to backwash one filter for not less than 15 minutes at the design rate of wash;

e. a washwater regulator or valve on the main washwater line to obtain the desired rate of filter wash with the washwater valves on the individual filters open wide;

f. a rate-of-flow indicator, preferably with a totalizer, on the main washwater line located so that it can be easily read by the operator during the washing process;

g. after washwater pumps are turned off and influent line opened, a rewash cycle shall be performed, during which period the water is filtered to waste until the turbidity is stabilized at approximately 0.3 NTU. Piping must be provided for this purpose to assure that the water is filtered to waste at a rate equivalent to the permitted filtration rate.

h. design to prevent rapid changes in backwash water flow.

10.3.10 <u>MISCELLANEOUS</u> - Roof drains shall not discharge into the filters or basins and conduits preceding the filters. Preferably, all filters be enclosed.

10.4.0 <u>PRESSURE FILTERS</u> - The normal use of these filters is for iron and manganese removal. Pressure filters shall not be used in the filtration of surface or other polluted waters, or following lime-soda softening.

10.4.1 <u>GENERAL</u> - Minimum criteria relative to number, rate of filtration, structural details and hydraulics, filter media, etc., provided for rapid rate gravity filters also apply to pressure filters where appropriate. Preferably, the rate shall not exceed three (3) gallons per minute per square foot of filter area.

10.4.2 <u>DETAILS OF DESIGN</u> - The filters shall be designed to provide for:

a. loss of head gauges on the inlet and outlet pipes of each filter;

b. an easily readable meter or flow indicator on each battery of filters. A flow indicator is to be installed for each filtering unit.

c. filtration and backwashing of each filter individually with an arrangement of piping as simple as possible to accomplish these purposes;

d. minimum side wall shell height of five feet. A corresponding reduction in side wall height is acceptable where proprietary bottoms permit reduction of the gravel depth.

e. the top of the washwater collectors to be at least 18 inches above the surface of the media;

f. the underdrain system to efficiently collect the filtered water and to uniformly distribute the backwash water at a rate not less than 15 gallons per minute per square foot of filter area;

g. backwash flow indicators and controls that are easily readable while operating the control valves;

h. an air release valve on the highest point of each filter;

i. an accessible manhole to facilitate inspection and repairs;

j. means to observe the wastewater during backwashing;

k. construction to prevent cross-connection.

10.5.0 DIATOMACEOUS EARTH FILTRATION - The use of these filters may be considered for application to surface waters with low turbidity and low bacterial contamination, and may be used for iron removal for groundwaters provided the removal is effective and the water is of satisfactory sanitary quality before treatment.

10.5.1 CONDITIONS OF USE - Diatomaceous earth filters are expressly excluded from consideration for the following conditions:

a. bacteria removal;

b. color removal;

c. turbidity removal where either the gross quantity of turbidity is high or the turbidity exhibits poor filterability characteristics;

d. filtration of waters with high algae counts.

10.5.2 PILOT PLANT STUDY - Installation of a diatomaceous earth filtration system shall be preceded by a pilot plant study on the water to be treated.

a. Conditions of the study such as duration, filter rates, head loss accumulation, slurry feed rates, turbidity removal, bacteria removal, etc., must be approved by the Division prior to the study.

b. Satisfactory pilot plant results must be obtained prior to preparation of final construction plans and specifications.

c. The pilot plant study must demonstrate the ability of the system to meet applicable drinking water standards at all times.

10.5.3 TYPES OF FILTERS - Pressure or vacuum diatomaceous earth filtration should be considered. However, the vacuum type is preferred for its ability to accommodate a design which permits observation of the filter surfaces to determine proper cleaning, damage to a filter element, and adequate coating over the entire filter area.

10.5.4 TREATED WATER STORAGE - Treated water storage capacity in excess of normal requirements shall be provided to:

a. allow operation of the filters at a uniform rate during all conditions of system demand at or below the approved filtration rate; and,

b. guarantee continuity of service during adverse raw water conditions without by-passing the system.

10.5.5 NUMBER OF UNITS - At least two (2) units shall be provided.

10.5.6 PRECOAT - The precoat shall conform to following:

a. Application - A uniform precoat 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.

b. 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 precoating is accomplished with a filter-to-waste system, 0.15 to 0.2 pounds per square foot of filter area is recommended.

10.5.7 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.

a. Quantity - Rate of body feed is dependent on raw water quality and characteristics and must be determined in the pilot plant study.

b. Operation and maintenance can be simplified by providing accessibility to the feed system and slurry lines.

c. Continuous mixing of the body feed slurry is required.

10.5.7 FILTRATION

a. Rate of Filtration - The recommended nominal rate is 1.0 gallon per minute per square foot of filter area with a recommended maximum of 1.5 gallons per minute per square foot. The filtration rate shall be controlled by a positive means.

b. Head Loss - The head loss shall not exceed 30 psi for pressure diatomaceous earth filters, or a vacuum of 15 inches of mercury for a vacuum system.

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.

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 inch is provided between elements or between any element and a wall.

e. Inlet Design - The filter influent shall be designed to prevent scour of the diatomaceous earth from the filter element.

10.5.8 BACKWASH - A satisfactory method to thoroughly remove and dispose of spent filter cake shall be provided.

10.5.8.1 APPURTENANCES - The following shall be provided for every filter:

a. sampling taps for raw and filtered water;

b. loss of head or differential pressure gauge;

c. rate-of-flow indicator, preferably with totalizer;

d. a throttling valve used to reduce rates below normal during adverse raw water conditions;

e. evaluation of the need for body feed, recirculation and any other pumps in accordance with this document.

10.5.9 MONITORING - An on-line continuous particle counting device and a continuous monitoring turbidimeter with recorder on the filter effluent is required for plants treating surface water.

10.6.0 DECLINING RATE FILTRATION - This is a design where no rate-of-flow controllers are installed. The rate of flow through the filter media is greatest when the media has just been back washed and gradually declines as the media becomes filled with contaminants.

a. The design must include means to insure that the water level during operation will not fall below the level of the top of the media.

b. The filtration rate must not exceed 6 gpm/ft^2 when the filter is clean (immediately following backwash) and uses dual or mixed media.

c. This design is normally appropriate only when four (4) or more filters are used in the plant.

10.7.0 <u>DIRECT FILTRATION</u>

10.7.1 <u>GENERAL</u>: Direct filtration, as used herein, refers to the filtration of a surface water without prior settling. The nature of the treatment process will heavily depend upon the raw water quality. A full scale direct filtration plant shall not be constructed without prior pilot studies which are acceptable to the Division. Where direct filtration is proposed, an engineering report shall be submitted prior to conducting pilot plant.

a. Will be considered on a case-by basis.

b. However, all filters shall have dual or mixed media and be operated at a rate between 2 and 5 gpm/ft^2.

c. A flash mix and flocculation basins shall be provided.

10.7.2 <u>ENGINEERING REPORT</u> - In addition to the items previously stated in this document under "Engineering Report", the report should include a historical summary of meteorological 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:

a. color;

b. turbidity;

c. microbiological/pathogen concentration;

d. microscopic biological organisms;

e. temperature;

f. total solids;

g. general inorganic, organic chemical and radiological characteristics;

h. additional parameters as may be required by the Division.

10.7.2.1 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.

10.8.0 <u>PILOT PLANT STUDIES</u> - After approval of the engineering report, a pilot study or in-plant demonstration study shall be conducted when required by the Division.

a. The study must be conducted over a sufficient time to treat all expected raw water conditions throughout the year.

b. The study shall emphasize but not be limited to, the following items:

1. chemical mixing conditions including shear gradients and detention periods;

2. chemical feed rates;

3. use of various coagulants and coagulant aids;

4. flocculation conditions;

5. filtration rates;

6. filter gradation, types of media and depth of media;

7. filter breakthrough conditions; and

8. adverse impact of recycling backwash water due to solids, pathogens, algae, disinfection by-products formation and similar problems.

c. Prior to the initiation of design plans and specifications, a final report including the engineer's design recommendations shall be submitted to the Division for review and approval.

d. The pilot plant filter must be of a similar type and operated in the same manner as proposed for full scale operation.

e. The pilot study must demonstrate the minimum contact time necessary for optimum filtration for each coagulant proposed.

10.8.1 PRETREATMENT - Rapid mix and flocculation - The final rapid mix and flocculation basin design should be based on the pilot plant or in-plant demonstration studies augmented with applicable portions of this document.

10.8.2 FILTRATION - Filters should be rapid rate gravity filters with dual or mixed media. The final filter design should be based on the pilot plant or in-plant demonstration studies augmented by applicable portions and in conformance with this document. Pressure filters or single media sand filters shall not be used.

10.8.3 CONTROL AND OPERATION – An online continuous particle counting device equipped with dual sensors and data processing system to demonstrate continuous removal of particles in a size range between 3 and 15 microns shall be installed. A continuous recording turbidimeter shall also be installed on each filter effluent line and on the composite filter effluent line. Additional continuous monitoring equipment, such as a streaming current detector, shall be provided to assist in control of coagulant dosage in optimizing the coagulation process.

10.8.4 SITING REQUIREMENTS - The plant design and land ownership surrounding the plant shall allow for the installation of conventional sedimentation basins should it be found that such are necessary.

10.9.0 SMALL WATER SYSTEM TECHNOLOGY

10.9.1 PACKAGE TREATMENT PLANTS AND ALTERNATIVE TECHNOLOGIES

10.9.1.1 GENERAL - These will be reviewed on a case-by-case basis based on pilot study demonstrated performance criteria. Membranes, cartridge filters and other alternative technologies may be considered at the discretion of the Division based on pilot study results and quality of the raw water supply.

10.9.2 PACKAGE PLANTS

a. Package plants using surface water sources shall meet the water treatment standards, procedures and instrumentation stated in this document.

b. Withdrawal of water directly from a surface source (i.e. river, stream, creek, lake, etc.) shall not be allowed.

c. A presedimentation treatment as discussed under "Presedimentation" section in the document and/or a plant reservoir with at least three-day storage capacity that would provide equivalent treatment shall be provided for the water entering the package treatment plant.

d. The turbidity concentration of the raw water entering the plant shall be consistently low (preferably not more than 10 NTU). In any case, it is preferred that the raw water supply source experience not more than a 20 NTU variation within any given 24 hour period.

e. Due to compressed treatment times, the operation of package treatment plants is even more critical than for conventional treatment plants.

f. The package plants should not operate in total automation mode without a qualified certified water operator available at all times to make the necessary treatment adjustments.

g. It is necessary that the operators of package plants are fully trained by the plant manufacturer's representatives.

10.9.3 OTHER ALTERNATIVE SURFACE WATER FILTRATION TECHNOLOGIES

a. Pilot plant studies shall be performed to demonstrate that the specific technology, in combination with the disinfection treatment, shall accomplish the required level of log removal of *Giardia* cysts and viruses and/or *Cryptosporidium* cysts, as specified by the drinking water standards.

b. The following stages of evaluation shall be performed:

   1. The first stage is to determine if the process effectively removes/inactivates the contaminants of concern;

      The alternative filtration technology, in combination with disinfection treatment must consistently achieve a minimum of 99.9 percent removal and/or inactivation *Giardia lamblia* cysts and 99.99 percent removal and/or inactivation of viruses, and a minimum of 99 percent removal of *Cryptosporidium* oocysts.

   2. The second stage is to determine if the individual system can effectively operate the process and to asses site-specific considerations that can affect the technology's performance.

c. In order to assure influent water quality within the designed criteria, pretreatment may be necessary with certain waters.

d. The level of water treatment operator skills and qualifications must be compatible with each piece of unit technology specified.

PART 11 - DISINFECTION

11.1.0 GENERAL - Chlorine is the disinfecting agent commonly used. Chlorination may be accomplished with liquid chlorine, calcium or sodium hypochlorites or chlorine dioxide. Other disinfecting agents will 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.

11.1.1 CHLORINATION EQUIPMENT

a. Type - Solution-feed gas chlorinators or hypochlorite feeders of the positive displacement type are acceptable.

b. Capacity - The chlorinator capacity shall be such that a free chlorine residual of at least two (2) milligrams per liter (mg/L) can be maintained in the water after contact time of at least 30 minutes when maximum flow rate coincides with anticipated maximum chlorine demand. The equipment shall be of such design that it will operate accurately over the desired feeding range.

c. Standby Equipment - Where chlorination is required for protection of the supply, 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.

d. Automatic Switchover - Automatic switchover of chlorine cylinders shall be provided, where necessary, to assure continuous disinfection. All surface water treatment plants must comply with this requirement.

e. Automatic Proportioning - Automatic proportioning chlorinators will be required where the rate of flow or chlorine demand is not reasonably constant or where the quality of the water is subject to rapid changes..

f. Eductor - Each eductor must be selected for the point of application with particular attention given to the quantity of chlorine to be added, the maximum injector waterflow, 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.

g. Injector/Diffuser – The chlorine solution injector/diffuser must 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.

11.1.2 CONTACT TIME AND POINT OF APPLICATION

11.1.2.1 GENERAL – 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, trihalomethanes formation potential and other pertinent factors. Chlorine should be applied at a point which will provide adequate contact time. All basins used for disinfection must be designed to minimize short circuiting.

a. Water must be continuously chlorinated to maintain a detectable residual of free chlorine in all parts of the distribution system in the recommended amount of at least 0.2 parts per million.

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

c. Water from a spring shall be disinfected and retained in a detention tank for a minimum of thirty (30) minutes unless otherwise approved by the Division; and such additional water treatment as the Division may require for the drinking water to comply with the rules.

d. Chemical feed equipment shall be of such design and capacity to accurately supply, at all times, the treatment chemicals required.

e. At plants treating surface water, provisions should be made for applying chlorine to the raw water, settled water, filtered water and water entering the distribution system. The contact time (CT) as required by the Division must be provided after filtration to achieve the level of inactivation of *Giardia* cysts and viruses through disinfection. The required CT shall be determined by conducting tracer studies as outlined in this section.

11.1.2.2 PROCEDURES FOR CONDUCTING TRACER STUDIES

11.1.2.2.1 The effectiveness of *Giardia* inactivation in a water treatment plant can be demonstrated through "CT" studies. The Surface Water Treatment Rule (SWTR) Guidance Manual defines CT as the residual disinfectant value multiplied by the minutes of available contact time. The time is measured from the disinfectant application point to the point where the residual is measured. For the inactivation of *Giardia* to meet SWTR requirements, only contact time prior to the first customer can be counted. Contact time, T_{10} (detention time for the calculation of CT), is defined as the point where 90% of the flow passing through a unit (clearwell, wetwell, storage tank, etc.) is retained within the unit. Flow through a pipe is calculated as plug flow and the total volume is included in the CT determination. That means to determine the contact time in minutes in a pipeline, calculate the volume of the pipeline in gallons and divide it by the maximum flow rate in gallons per minute.

Detention time established by tracer tests may be used to estimate "CT" with flow rates less than or equal to the tracer test flow. For this reason, use of worst case evaluations can provide reliable CT value determinations under all permitted operating conditions. This may eliminate the need for conducting multiple studies at several different plant flows. Once CT has been calculated (remember CT is the product of the retention time (T,,) in minutes and the disinfectant residual in mg/L measured at the exit/end of the unit or pipeline) , the log inactivation of *Giardia* can be determined using the "CT Table" that corresponds to the water temperature and pH.

The Guidance Manual (GM) describes two procedures for determining contact time using tracer materials. Both procedures involve measuring tracer concentrations versus time. The step-dose procedure is readily adaptable to most Georgia water plants because existing equipment can be utilized with minimal modifications. The slug-dose procedure may require some plant modifications and offers no advantage over the former procedure. Only the step-dose procedure for conducting a tracer study to determine T_{10} is outlined in this document.

Recommended tracer materials are fluoride compounds due to availability, cost and compatibility with existing plant equipment. In addition, fluoride concentration is easily measured with routine laboratory analyses using existing equipment. Depending on baseline concentrations, application of 3 mg/L of fluoride should be adequate. The maximum fluoride level should not exceed 4.0 mg/L. To insure accurate results, the selected test method should be conducted maintaining constant plant flow rates (at maximum or worst case) and plant finished water storage volume representing no more than 30% of capacity. During the study, finished water outflow (pumped or gravity flow) should equal or exceed plant inflow to provide conservative CT value estimates.

Using the recommended step-dose method, a constant tracer addition is started and timed until the concentration stabilizes at the sampling point. If the fluoride addition is then discontinued, the receding fluoride values may be monitored and used for verification purposes. In contrast, the slug-dose method requires an instantaneous tracer addition and measurement at the sampling point over time. Successful use of this method is directly related to post chemical mixing efficiency to avoid distortions associated with density currents.

Before attempting a tracer test, the plant supervisor should develop a plan to insure proper coordination of all system components. The planning must provide a system balance while conducting the test, which precludes activities, such as filter backwashing, which could significantly distort test results. Some plants may have site specific features that require modification to properly conduct a tracer test. Please call the Drinking Water Program for information if there are questions concerning areas not listed in the attached procedures.

11.1.2.2.2 **TRACER TEST PROCEDURES**

1. Select tracer chemical. Fluoride compounds are used in virtually all surface water treatment plants in Georgia and are the recommended choice.

2. The total fluoride concentration should not exceed 4 mg/L. Remember to verify the available fluoride content of the product being used for your study. Sodium silicofluoride usually contains about 60% available fluoride, while sodium fluoride contains about 44% fluoride.

3. Discontinue routine fluoride application 24 to 48 hours prior to the scheduled tracer study. This will allow the fluoride level in the water in the clearwell to drop to background (baseline concentration).

4. Determine the tracer (fluoride) background level by testing filtered water prior to fluoride addition. Do not start the study until the fluoride concentration in the water leaving the plant is the same as the background level.

5. Provide a bypass flush connection to waste on the fluoride solution line just prior to its application (injection) point.

6. Adjust the fluoride output to the desired application rate (this value is referred to as C_0) and verify by weighing output several times, especially if using a volumetric feeder. Verify the feed rate again about midway and at the conclusion of the test. (If significant output variations are noted, a repeat test may be required.) After obtaining the desired feed output, operate the feeder for 30 minutes while discharging the fluoride solution to waste at the application (injection point). This procedure will allow the fluoride concentration to stabilize in the feeder solution chamber and pipe.

   Example: Using sodium silicofluoride as the selected tracer, the amount of chemical required is determined as follows:

   1. Assume 60% fluoride concentration
   2. Application (dosage) rate of 3 mg/L (C_0)
   3. 1 MGD plant flow

   Calculation:

$$\frac{8.34 \times 1.0 \text{ MGD} \times 3 \text{ mg/L}}{0.60} = 41.7 \text{ lbs}$$

$$\frac{41.7 \text{ lbs} \times 454 \text{ grams/lb}}{1440} = 13.1 \text{ grams/min}$$ Na_2SiF_6 required from the feeder

7. The sampling point should represent direct discharge into the distribution system. Excessively long sample lines or taps from plant service water lines can distort actual detention values and must be avoided. In some cases installation of representative sampling tap(s) may be necessary.

8. Close the bypass flush valve and start allowing the fluoride solution into the filtered water through the injection point. Note and record the time (a stopwatch is recommended) and begin sampling the finished water leaving the clearwell/plant at 3 to 5 minute intervals using clean, clearly marked sampling containers. Continue sampling until the fluoride concentration in the finished water has stabilized for several sampling intervals. The stabilized fluoride concentration should be approximately equal to the fluoride dose applied (3 mg/L in the previous example) plus the background (baseline) concentration contained in the filtered water prior to fluoride addition. Note: if your clearwell has a large theoretical retention time (greater than 4 hours), sampling may be conducted at 10 minute intervals for the first 30 minutes, or until a tracer concentration above baseline is first detected. Once a concentration change is first observed, immediately change to the 3 to 5 minute sampling interval. For verification of the test, the tracer (fluoride) feed should be discontinued, and the receding fluoride concentration at the effluent should be sampled and monitored at the same frequency (3 to 5 minute intervals) until the fluoride concentration returns to background. The time at which the fluoride feed is stopped is time zero for the receding tracer test and must be noted. The receding tracer test will provide a replicate set of measurements which can be compared with data derived from the rising tracer concentration versus time curve.

9. Fluoride analyses should be conducted using standardized instrumentation, fresh reagents and clean glassware. Fluoride levels exceeding about 2.0 mg/L must be accurately diluted with distilled water before calorimetric analysis.

10. During the tracer test, the analytical results versus time should be tabulated in the columns on the enclosed "Step-Dose Tracer Test Data" form and used to determine T_{10} as shown in the following example taken from the SWTR Guidance Manual.

11. For each tracer study performed, a completed copy of the enclosed "Tracer Study Report" form, the "Step-Dose Tracer Test Data" form and a copy of the graphical analysis for determining T_{10} (see Figure C-1, a graph of C/C_0 vs. Time) must be submitted to the Division.

EXAMPLE from U.S.EPA SWTR Guidance Manual:

a. Step-Dose Method Test -For the step-dose test a constant fluoride dosage of 2.0 mg/L was added to the clear-well inlet. Fluoride levels in the clearwell effluent were monitored and recorded every 3 minutes. The raw tracer study data, along with the results of further analyses are shown in Table C-1.

TABLE C-1

CLEARWELL DATA-STEP-DOSE TRACER TEST[1,2,3]

	Fluoride Concentration		
t , minutes	Measured, mg/L	Tracer, mg/L	Dimensionless, C/C_0
0	0.20	0	0
3	0.20	0	0
6	0.20	0	0
9	0.20	0	0
12	0.29	0.09	0.045
15	0.67	0.47	0.24
18	0.94	0.74	0.37
21	1.04	0.84	0.42
24	1.44	1.24	0.62
27	1.55	1.35	0.68
30	1.52	1.32	0.66
33	1.73	1.53	0.76
36	1.93	1.73	0.86
39	1.85	1.65	0.82
42	1.92	1.72	0.86
45	2.02	1.82	0.91
48	1.97	1.77	0.88
51	1.84	1.64	0.82
54	2.06	1.86	0.93
57	2.05	1.85	0.92
60	2.10	1.90	0.95
63	2.14	1.94	0.96

1. Baseline concentration = 0.2 mg/L, fluoride dose = 2.0 mg/L , [C_0 = 2.0 mg/L]
2. Measured concentration = Tracer concentration + Baseline concentration
3. Tracer concentration.= Measured concentration - Baseline concentration

The steps in evaluating the raw data shown in the first column of Table C-1 are as follows. First, the baseline fluoride concentration, 0.2 mg/L, is subtracted from the measured concentration to give the fluoride concentration resulting from the tracer study addition alone. For example, at elapsed time = 39 minutes, the tracer fluoride concentration, C, is obtained as follows:

$C = C_{measured} - C_{baseline}$
C = 1.85 mg/L - 0.2 mg/L
C = 1.65 mg/L

This calculation was repeated at each time interval to obtain the data shown in the third column of Table C-1. As indicated, the fluoride concentration rises from 0 mg/L at t = 0 minutes to the applied fluoride dosage of 2 mg/L, at t = 63 minutes.

The next step is to develop dimensionless concentrations by dividing the tracer concentrations in the second column of Table C-1 by the applied fluoride dosage, Co = 2 mg/L. For time = 39 minutes, C/Co is calculated. as follows:

$C/Co = (1.65 \text{ mg/L})/(2.0 \text{ mg/L})$
$C/C_0 = 0.82$

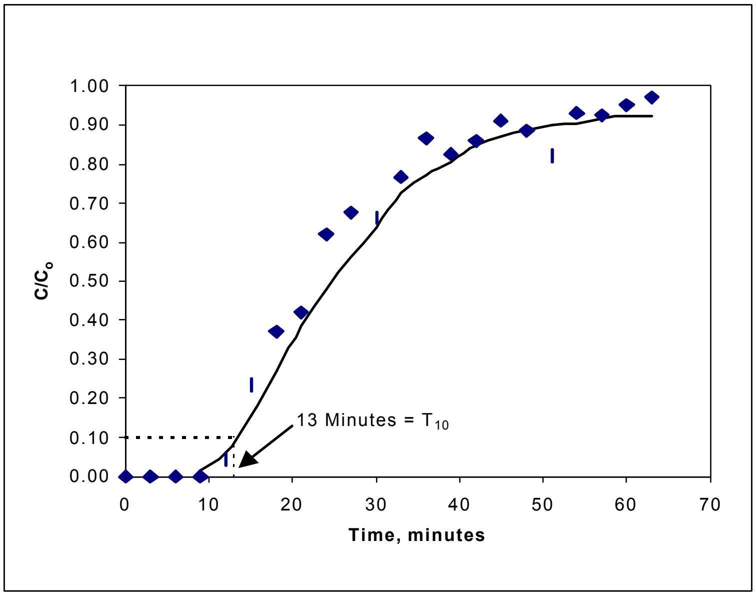
The resulting dimensionless data, presented in the fourth column of Table C-1, is the basis for completing the determination of T_{10} by either the graphical or numerical method.

In order to determine T_{10} by the graphical method, a plot of C/Co vs. time should be generated using the data in Table C-1. A smooth curve should be drawn through the data as shown on Figure C-1.

T_{10} is read directly from the graph at a dimensionless concentration (C/Co) corresponding to the time for which 10 percent of the tracer has passed at the effluent end of the contact basin (T_{10}). For step-dose method tracer studies, this dimensionless concentration is C/Co = 0.10.

T_{10}.should be read directly from Figure C-1 at C/Co = 0.1 by first drawing a horizontal line (C/Co = 0.1) from the Y-axis (t = 0) to its intersection with the smooth curve drawn through the data. At this point of intersection, the time read from the X-axis is T_{10} and may be found by extending a vertical line downward to the X-axis. These steps were performed as illustrated on Figure C-1, resulting in a value for T_{10} of approximately 13 minutes.

FIGURE C-1 - C/C_0 vs. Time (Graphical Analysis for T_{10})



CT Values Tables: CT Values for Inactivation of *Giardia* cysts by Free Chlorine at 5^0 C.

Chlorine Concentration (mg/L)	pH < = 6.5 Log Inactivation 0.5	1.0	1.5	2.0	2.5	3.0
< = 0.4	20	39	59	78	98	117
0.6	20	40	60	80	100	120
0.8	20	41	61	81	102	122
1	21	42	63	83	104	125
1.2	21	42	64	85	106	127
1.4	22	43	65	87	108	130
1.6	22	44	66	88	110	132
1.8	23	45	68	90	113	135
2	23	46	69	92	115	138
2.2	23	47	70	93	117	140
2.4	24	48	72	95	119	143
2.6	24	49	73	97	122	146
2.8	25	49	74	99	123	148
3	25	50	76	101	126	151

Chlorine Concentration (mg/L)	pH = 7.0 Log Inactivation 0.5	1.0	1.5	2.0	2.5	3.0
< = 0.4	23	46	70	93	116	139
0.6	24	48	72	95	119	143
0.8	24	49	73	97	122	146
1	25	50	75	99	124	149
1.2	25	51	76	101	127	152
1.4	26	52	78	103	129	155
1.6	26	53	79	105	132	158
1.8	27	54	81	108	135	162
2	28	55	83	110	138	165
2.2	28	56	85	113	141	169
2.4	29	57	86	115	143	172
2.6	29	58	88	117	146	175
2.8	30	59	89	119	148	178
3	30	61	91	121	152	182

Chlorine Concentration (mg/L)	pH < = 7.5 Log Inactivation 0.5	1.0	1.5	2.0	2.5	3.0
< = 0.4	28	55	83	111	138	166
0.6	29	57	86	114	143	171
0.8	29	58	88	117	146	175
1	30	60	90	119	149	179
1.2	31	61	92	122	153	183
1.4	31	62	94	125	156	187
1.6	32	64	96	128	160	192
1.8	33	65	98	131	163	196
2	33	67	100	133	167	200
2.2	34	68	102	136	170	204
2.4	35	70	105	139	174	209
2.6	36	71	107	142	178	213
2.8	36	72	109	145	181	217
3	37	74	111	147	184	221

TRACER STUDY REPORT

Water System Name: ______________________________________ ID#: _________________

Water Plant Name: _______________________________________County: ________________

Date Tracer Test Performed: ________________________________

Water Treatment Capacity (MGD): Permitted: __________________________ MGD
As Tested: __________________________ MGD

Finished Water Flow (MGD): Maximum: __________________________ MGD
As Tested: __________________________ MGD

Clearwell Storage

No.	Capacity (MG)	Water Level (ft)	
		Full	As Tested

Disinfectant application point(s): ____
____
Disinfectant residual sample locations: ____
____

Disinfectant Residual : __________________ mg/L
pH value : _____________________________
Water temperature: ____________________ ^{0}C

Tracer Chemical Selected: ____
Background tracer concentration: ______________________________ mg/L
Tracer Dosage (C_0): ____ mg/L
Point of tracer application (should be same as disinfectant application point):____________
____

Sample location(s) for tracer measurement (should be same as disinfectant residual sampling point): ____
____

Fluoride testing method: ____

Sampling intervals: _________________________ minutes

STEP-DOSE TRACER TEST DATA

Date: ______________________________________

Sample No.	Time (minutes)	Fluoride Concentration (mg/L)		
		Measured	Tracer (C) Measured-baseline	Dimensionless C/C_0

Remember: C_0 is the tracer (fluoride) concentration used during the test.

11.2.0 CHLORINE TESTING EQUIPMENT

a. 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 to the nearest 0.1 milligrams per liter in the range below 0.5 milligrams per liter, to the nearest 0.3 milligrams per liter between 0.5 milligrams per liter and 1.0 milligrams per liter and to the nearest 0.5 milligrams per liter between 1.0 milligrams per liter and 2.0 milligrams per liter.

b. Automatic chlorine residual recorders shall be provided for each surface public water system or a ground water source under the direct influence of surface water for continuously monitoring the residual disinfectant concentration of the water entering the distribution system. Exception to this requirement may be made for the smaller systems serving 3,300 or fewer people, as prescribed in the Georgia Rules for Safe Drinking Water, Chapter 391-3-5.

11.2.1 CHLORINATOR PIPING

a. The chlorinator water supply piping shall be designed to prevent contamination of the treated water supply by sources of questionable quality.

b. At all facilities treating surface water, pre- and post-chlorination systems must be independent to prevent possible siphoning of partially treated water into the clearwell. A check valve should be provided for the pre-chlorination line near the eductor.

c. The water supply to each eductor shall have a separate shut-off valve. No master shut-off valve will be allowed.

d. The pipes carrying elemental liquid or dry gaseous chlorine under pressure must be Schedule 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 must be used for chlorine solution piping and fittings. Nylon products are not acceptable for any part of the chlorine solution piping system.

11.2.2 HOUSING FOR CHLORINATION EQUIPMENT - Adequate housing must be provided for the chlorination equipment and for storing the chlorine.

a. In addition to the applicable items stated in Part 19, "Chemical Application", in this document, the following must be included:

1. Gas chlorination equipment and cylinders must be housed in a separate room or facility provided for that purpose and be separated from the other treatment facilities and chemicals.

Hypochlorite feeders are not required to be placed in a separate room or facility.

2. Chlorine cylinders stored or used outdoors must be protected from the direct rays of the sun by shading and additionally protected to prevent unauthorized tampering.

3. Chlorine cylinders must be secured from accidental tipping or movement.

4. A chlorine gas mask or self contained gas mask (air pack) must be provided outside the gas chlorine room or facility or otherwise made available and be readily accessible to the operator for repairs or emergencies.

5. Forced air ventilation, placed near floor level and near the cylinders, must be provided to exhaust any leaking chlorine gas. Exhaust fumes must be directed away from the entrance to the room or facility. The fan must be activated by an outside switch or start automatically when the door is opened.

6. A small bottle of fresh ammonia solution shall be provided for testing for chlorine gas leaks.

7. There must be sufficient space for chemical storage.

b. OTHER DISINFECTING AGENTS - Proposals for use of disinfecting agents other than chlorine such as iodine or ozone treatment may be approved by the Division prior to preparation of final plans and specifications.

PART 12 - SOFTENING

12.1.0 GENERAL - The softening process selected must 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.

a. Lime or Lime-Soda Process - For design standards for rapid mix, flocculation and sedimentation, refer to the applicable sections in this document. Additional consideration must be given to the following process elements.

   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 must be provided.

b. Aeration - Determinations should be made for the carbon dioxide (CO_2) content of the raw water. When concentrations exceed 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.

c. Chemical Feed Point - Lime and recycled sludge should be fed directly into the rapid mix basin.

d. Rapid Mix - Rapid mix basins must provide not more than 30 seconds detention time with adequate velocity gradients to keep the lime particles dispersed.

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

f. Sludge Collection - Mechanical sludge removal equipment should be provided in the sedimentation basin. Sludge recycling to the rapid mix should be provided.

g. Sludge Disposal - Provisions must be included for proper disposal of softening sludges.

h. Disinfection - The use of excess lime shall not be considered an acceptable substitute for disinfection.

i. Plant Start-Up - The plant processes must be manually started following shut-down.

j. Cation Exchange Process - Alternative methods of hardness reduction should be investigated when the sodium content and dissolved solids concentration is of concern.

k. 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, is one milligram per liter or more. Waters having 5 units or more turbidity should not be applied directly to the cation exhange softener.

l. 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 (suggested for small plants). A manual override shall be provided on all automatic controls.

m. Exchange Capacity - The design capacity for hardness removal should not exceed 20,000 grains per cubic foot when resin is regenerated with 0.3 pounds of salt per kilogram of hardness removed.

n. Depth of Resin - The depth of the exchange resin should not be less than three (3) feet.

o. Flow Rates - The rate of softening should not exceed seven gallons per minute per square foot of bed area (7 gpm/ft^2) and the backwash rate should be six to eight gallons per minute per square foot of bed area (6 gpm/ft^2). Rate-of-flow controllers or the equivalent must be installed for the above purposes.

p. Freeboard - The freeboard will depend upon the specific gravity of the resin and the direction of water flow. Generally, the washwater collector should be 24 inches above the top of the resin on downflow units.

q. Underdrains and Supporting Gravel - The bottoms, strainer systems and support for the exchange resin shall conform to criteria provided for rapid rate gravity filters. Refer to applicable sections in this document.

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

s. 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.

t. By-Pass Piping and Equipment - A bypass must be provided around softening units to produce a blended water of desirable hardness.

Totalizing meters must be installed on the bypass line and on each softener unit. The bypass line must have a shutoff valve and should have an automatic proportioning or regulating device. In some installations, it may be necessary to treat the bypassed water to obtain acceptable levels of iron and/or manganese in the finished water.

u. Additional Limitations - Silica gel resins should not be used for waters having a pH above 8.4 or containing less than six 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.

v. Sampling Taps - Smooth-nose sampling taps must 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 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.

12.1.1 BRINE AND SALT STORAGE TANKS

a. Salt dissolving or brine tanks and wet salt storage tanks must be covered and must be corrosion-resistant.

b. The make-up water inlet must 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.

c. Wet salt storage basins must be equipped with manholes or hatchways for access and for direct dumping of salt from truck or railcar. Openings must be provided with raised curbs and watertight covers having overlapping edges similar to those required for finished water reservoirs.

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

e. Two wet salt storage tanks or compartments designed to operate independently should be provided.

f. The salt shall be supported on graduated layers of gravel placed over a brine collection system.

g. Alternative designs which are conducive to frequent cleaning of the wet salt storage tank may be considered.

12.1.2 SALT AND BRINE STORAGE CAPACITY - Total salt storage should have sufficient capacity to store in excess of 1-1/2 carloads or truckloads of salt, and provide for at least 30 days of operation.

12.1.3 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.

12.1.4 STABILIZATION - Stabilization for corrosion control shall be provided.

12.1.5 WASTE DISPOSAL - Acceptable disposal must be provided for the brine waste. Where the volume of spent brine must be reduced, consideration may be given to using a part of the spent brine for a subsequent regeneration.

12.1.6 CONSTRUCTION MATERIALS - Pipes and contact materials must be resistant to the aggressiveness of salt. Plastic and red brass are acceptable piping materials. Steel and concrete must be coated with a non-leaching protective coating which is compatible with salt and brine.

12.1.7 HOUSING - Bagged salt and dry bulk salt storage shall be enclosed and separated from other operating areas in order to prevent damage to equipment.

PART 13 - AERATION

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

a. A by-pass shall be provided for all aeration units.

b. The aggressiveness of the water after aeration should be determined and corrected by additional treatment, if necessary.

13.1.1 NATURAL DRAFT AERATION - Design shall provide:

a. perforations in the distribution pan 3/16 to 1/2 inches in diameter, spaced 1 to 3 inches on centers to maintain a six inch water depth;

b. for distribution of water uniformly over the top tray;

c. discharge through a series of three or more trays with separation of trays not less than 12 inches;

d. loading at a rate of 1 to 5 gallons per minute for each square foot of total tray area;

e. trays with slotted, heavy wire (1/2 inch openings) mesh or perforated bottoms;

f. construction of durable material resistant to aggressiveness of the water and dissolved gases;

g. protection from loss of spray water by wind carriage by enclosure with louvers sloped to the inside at a angle of approximately 45 degrees;

h. protection from insects by 24-mesh screen;

i. aerated water receives disinfection treatment.

13.1.2 FORCED OR INDUCED DRAFT AERATION - Devices shall be designed to:

a. include a blower with a weatherproof motor in a tight housing and screened enclosure;

b. insure adequate counter current of air through the enclosed aerator column;

c. exhaust air directly to the outside atmosphere;

d. include a down-turned and 24-mesh screened air outlet and inlet;

e. be such that air introduced in the column shall be as free from obnoxious fumes, dust and dirt as possible;

f. 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;

g. provide loading at a rate of 1 to 5 gallons per minute for each square foot of total tray area;

h. insure that the water outlet is adequately sealed to prevent unwarranted loss of air;

i. discharge through a series of five or more trays with separation of trays not less than six inches;

j. provide distribution of water uniformly over the top tray;

k. be of durable material resistant to the aggressiveness of the water and dissolved gases.

13.1.3 PRESSURE AERATION: Pressure aeration may be used for oxidation purposes only if pilot plant study indicates the method is applicable. It is not acceptable for removal of dissolved gases. Filters following pressure aeration must have adequate exhaust devices for release of air. Pressure aeration devices shall be designed to:

a. give thorough mixing of compressed air with water being treated;

b. provide screened and filtered air, free of obnoxious fumes, dust, dirt and other contaminants.

13.1.4 PACKED TOWER AERATION - Packed tower aeration (PTA) which 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 100 (expressed in atm mol/mol) at 12^{0}C), but not normally feasible for removing compounds with a Henry’s Constant less than 10. For values between 10 and 100, PTA may be feasible but should be extensively evaluated using pilot studies.

13.1.4.1 Process Design

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 project shall provide justification for the design parameters selected (i.e. height and diameter of 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 Division may consider approval of the process design based on use of appropriate calculations without pilot testing. The proposals of this type must be discussed with the Division prior to preparation of the design plans and specifications.

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

c. The ratio of the column diameter to packing diameter should be at least 7:1 for the pilot unit and at least 10:1 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.

d. The minimum volumetric air to water ratio at peak water flow should be 25:1. The maximum air to water ratio for which credit will be given is 80:1.

e. The design should consider potential fouling problems from calcium carbonate and iron precipitation and from bacterial growth. It may be necessary to provide pretreatment.

f. Disinfection capability shall be provided prior to and after PTA.

g. The effects of temperature should be considered since a drop in water temperature can result in a drop in contaminant removal efficiency.

13.1.4.2 Materials of Construction - The tower can 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.

13.1.4.3 Water Flow - Water should be distributed uniformly at the top of the tower using spray nozzles or orifice-type distributor trays that prevent short-circuiting. In addition,

a. A mist eliminator shall be provided above the water distributor system.

b. A side wiper-redistribution ring should be provided at least every 10 feet in order to prevent water channeling along the tower wall and short circuiting.

c. Sample taps shall be provided in the influent and effluent piping.

d. 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.

e. A blow-off line should be provided in the effluent piping to allow for discharge of water/chemicals used to clean the tower.

f. 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.

g. The water flow to each tower shall be metered.

h. An overflow line shall be provided which discharges 12 to 14 inches above a splash pad or drainage inlet. Proper drainage shall be provided to prevent flooding of the area.

13.1.4.4 Air Flow System

a. The air inlet to the blower and tower discharge vent shall be protected with a noncorrodible 24-mesh downturned screen to prevent contamination from extraneous matter.

b. The air inlet shall be in a protected location.

c. An air flow meter shall be provided on the influent air line or an alternative method to determine the air flow shall be provided.

d. A backup motor for the air blower must be readily available.

13.1.4.5 Other Features to be Provided

a. A sufficient number of access ports with a minimum diameter of 24 inches to facilitate inspection, media replacement, media cleaning and maintenance of the interior.

b. A method of cleaning the packing material when iron, manganese or calcium carbonate fouling may occur.

c. Tower effluent collection and pumping wells constructed to clearwell standards.

d. Provisions for extending the tower height without major reconstruction.

e. An acceptable alternative supply must be available during periods of maintenance and operation interruptions. No bypass shall be provided unless specifically approved by the Division.

f. Disinfection application points both ahead of and after the tower to control biological growth.

g. Disinfection and adequate contact time after the water has passed through the tower and prior to the distribution system.

h. Adequate packing support to allow free flow of water and to prevent deformation with deep packing heights.

i. Operation of the blower and disinfectant feeder equipment during power failures.

j. Adequate foundation to support the tower and lateral support to prevent overturning due to wind loading.

k. Fencing and locking gate to prevent vandalism.

l. An access ladder with safety cage for inspection of the aerator including the exhaust port and de-mister.

m. Electrical interconnection between blower, disinfectant feeder and well pump.

13.1.4.6 Environmental Factors

a. The applicant must contact the Division's Air Quality Branch to determine if permits are required under the Clean Air Act.

b. Noise control facilities should be provided on PTA systems located in residential areas.

13.1.4.7 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 processes must be designed to meet the particular needs of the water to be treated and are subject to the approval of the Division.

13.1.4.8 Protection of Aerators from Contamination - 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 aerators.

13.1.4.9 Disinfection - Groundwater supplies exposed to the atmosphere by aeration must receive disinfection treatment as the minimum additional treatment.

13.1.4.10 By-Pass - A by-pass shall be provided for all aeration units.

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

PART 14 - IRON AND MANGANESE CONTROL TREATMENT

14.1.0 GENERAL - Iron and manganese control, as used herein, 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 or more treatment processes must meet specific local conditions as determined b engineering investigations, including chemical analyses of representative samples of water to be treated, and receive the approval of the 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 pH of the raw water to optimize the chemical reaction. Testing equipment and sampling taps shall be provided as outlined in this document.

14.1.1 REMOVAL BY OXIDATION, DETENTION AND FILTRATION

a. Oxidation - Oxidation may be by aeration, as outlined in this document**,** or by chemical oxidation with chlorine, potassium permanganate, ozone or chlorine dioxide.

b. Detention - A detention time of at least 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. Sedimentation basins shall be provided when treating water with high iron and/or manganese content, or where chemical coagulation is used to reduce the load on the filters. Provisions for sludge removal shall be made.

c. Filtration - Filters shall be provided and shall be in conformance with this document. Filtration rate normally should not exceed 3 gpm/ft^2 of filter area.

14.1.2 REMOVAL BY THE LIME-SODA SOFTENING PROCESS - See applicable Section in this document.

14.1.3 REMOVAL BY MANGANESE GREENSAND FILTRATION - This process, consists of a continuous feed of potassium permanganate to the influent of a manganese greensand filter.

a. The permanganate should be applied as far ahead of the filter as practical.

b. 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.

c. Anthracite media cap of at least six inches shall be provided over manganese treated greensand.

d. Normal filtration rate is 3 gpm/ft^2 of filter area.

e. Normal wash rate is 8 to 10 gpm/ft^2.

f. Air washing should be provided.

g. Sample taps shall be provided at the following locations:

  1. prior to application of permanganate;

  2. immediately ahead of filtration;

  3. at points between the anthracite media and the manganese treated greensand media;

  4. halfway down the manganese treated greensand media;

  5. at the filter effluent.

14.1.4 REMOVAL BY ION EXCHANGE - This process of iron and manganese removal should not be used for water containing more than 0.3 milligrams per liter of iron, manganese or combination thereof. This process is not acceptable where either the raw water or wash water contains dissolved oxygen.

14.1.5 SEQUESTRATION BY POLYPHOSPHATES - This process is generally suitable only for low contents of iron and manganese where iron, manganese or combination thereof does not exceed 1.0 milligrams per liter. The total phosphate applied should not exceed 10 milligrams per liter as PO_4 or as recommended by the product supplier in accordance with the NSF Standard 60 listing. Where phosphate treatment is used, satisfactory chlorine residuals shall be maintained in the distribution system. In addition, a systematic flushing program shall be established and maintained for the distribution system.

a. Feeding equipment shall be as outlined in this document.

b. Stock phosphate solution must be kept covered and disinfected by carrying approximately 10 milligrams per liter free chlorine residual.

c. 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.

d. Phosphate compounds used must be certified for conformance with NSF Standard 60.

14.1.6 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 must accompany or closely precede the sodium silicate addition. Injection of sodium silicate more than 15 seconds after oxidation may cause detectable loss of chemical efficiency. Dilution of feed solutions much below five percent (5%) silica as SiO_2 should also be avoided for the same reason.

a. Sodium silicate addition is applicable to waters containing up to 2 mg/l of iron, manganese or combination thereof.

b. Chlorine residuals shall be maintained throughout the distribution system to prevent biological breakdown of the sequestered iron.

c. The amount of silicate added shall be limited to 20 mg/l as SiO_2 but the amount of added and naturally occurring silicate shall not exceed 60 mg/l as SiO_2.

d. Feeding equipment shall be as outlined in this document.

e. Sodium silicate shall not be applied ahead of iron or manganese removal treatment.

f. Liquid sodium silicate must be certified for conformance with NSF Standard 60.

14.1.7 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.

14.1.8 Testing Equipment - 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.

PART 15 - FLUORIDATION

15.1.0 GENERAL - Sodium fluoride, sodium silicofluoride and hydrofluosilicic acid shall conform to the applicable AWWA standards. Other fluoride compounds which may be available must be approved by the Division.

15.1.1 FLUORIDE COMPOUND STORAGE

a. Fluoride chemicals should be isolated from other chemicals to prevent contamination.

b. Compounds shall be stored in covered or unopened shipping containers and should be stored inside a building.

c. Bulk storage units and day tanks, drums in use and unsealed storage units for hydrofluosilicic acid should be vented to the atmosphere at a point outside any building.

d. Bags, fiber drums and steel drums should be stored on pallets.

15.1.2 CHEMICAL FEED EQUIPMENT AND INSTALLATIONS

15.1.2.1 GENERAL - In addition to the requirements listed under "Chemical Application" in this document, the fluoride feed equipment shall meet the following requirements:

a. shall provide scales, loss-of-weight recorders or liquid level indicators, as appropriate for dry or acid chemical feeds. Dry volumetric feeders are to have percent-of cycle timer or variable speed drive. A minimum of 35-gallon dissolver with mechanical mixer.

b. feeders shall be accurate to within 5 % of any desired feed rate;

c. fluoride compound shall not be added before lime-soda softening or ion exchange softening;

d. the point of application of hydrofluosilicic acid, if into a horizontal pipe, shall be in the lower half of the pipe;

e. a fluoride solution shall be applied by a positive displacement pump having a stroke rate not less than 20 strokes per minute;

f. anti-siphon devices shall be provided for all fluoride feed lines and dilution water lines;

g. a device to measure the flow of water to be treated is required;

h. the dilution water pipe shall terminate at least two pipe diameters above the solution tank;

i. water used for sodium fluoride dissolution shall be softened if hardness exceeds 75 mg/l as calcium carbonate;

j. fluoride solutions shall not be injected to a point of negative pressure;

k. the electrical outlet used for the fluoride feed pump should have a nonstandard receptacle and shall be interconnected with the well or service pump;

l. saturators should be of the upflow type and be provided with a meter and backflow protection on the makeup water line.

15.1.3 PROTECTIVE EQUIPMENT - Protective equipment, as outlined in Part 19, titled "Chemical Application" shall be provided for operators handling fluoride compounds.

15.1.4 DUST CONTROL

a. 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 which may enter the room in which the equipment is installed.

b. The enclosure shall be provided with an exhaust fan and dust filter which place the hopper under a negative pressure. Air exhausted from fluoride handling equipment shall discharge through a dust filter to the outside atmosphere of the building.

c. The disposal of empty bags, drums or barrels shall be in a manner to minimize exposure to fluoride dusts.

d. A floor drain should be provided to facilitate the hosing of floors.

15.1.5 TESTING EQUIPMENT - Equipment shall be provided for measuring the quantity of fluoride in the water. Such equipment shall be acceptable to the Division.

PART 16 - CORROSION CONTROL

16.1.0 GENERAL - To control corrosion, certain basic approaches can be utilized:

a. Using pipe materials and designing the system so it is not corroded by a given water;

b. Modifying the water quality so it is not corrosive to the pipe material;

c. Placing a protective barrier or lining between the water and the pipe.

16.1.1 SYSTEM DESIGN

a. Choose compatible materials throughout the system where possible to avoid forming galvanic cells;

b. Avoid dead ends and stagnant areas;

c. Reduce mechanical stress, sharp turns and elbows;

d. Provide adequate insulation and avoid uneven heat distribution;

e. Eliminate grounding of electrical circuits to system.

16.1.2 CATHODIC PROTECTION - Metal tanks and reservoirs should be considered for protection from corrosion by this method.

16.1.3 MODIFICATION OF WATER QUALITY - pH adjustment by the addition of lime, caustic soda or soda ash in order to stabilize the water with regard to calcium carbonate. Advantages of aeration for iron, H_2S or $C0_2$ removal should be balanced against the fact that dissolved oxygen is a corrosive agent.

16.1.4 USE OF INHIBITORS - These may be used as appropriate.

a. Addition of lime or alkalinity increases the tendency of water to deposit $CaCO_3$ forming a protective coating inside of pipe.

b. A phosphate compound which not only masks the symptoms of red water due to iron, but also reduces corrosion can be selected.

c. Sodium silicate can be effective in water with low hardness, alkalinity, and pH less than 8.4 under relatively high velocity conditions.

16.1.5 COATINGS AND LININGS – Metal distribution system components' surfaces in contact with water shall be protected by being coated or lined. Coatings and linings used must be certified for conformance with NSF Standard 61.

16.1.6 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.

PART 17 - TASTE AND ODOR CONTROL

17.1.0 GENERAL

a. Provision shall be made for the control of taste and odor at all water treatment plants.

b. Chemicals shall be added sufficiently ahead of other treatment processes to assure adequate contact time for an effective and economical use of the chemicals.

c. Where severe taste and odor problems are encountered, in-plant and/or pilot plant studies may be required.

17.1.1 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.

17.1.2 CHLORINATION - Chlorination can be used for the removal of some objectionable odors. Adequate contact time must 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 design.

17.1.3 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.

17.1.4 POWDERED ACTIVATED CARBON

a. 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.

b. 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”.

c. Continuous agitation is necessary to keep the carbon from depositing in the mixing tank.

d. Provision shall be made for adequate dust control.

e. The required rate of feed of carbon in a water treatment plant depends upon the tastes and/or odors involved, but provision should be made for adding from 0.1 mg/L to at least 40 mg/L.

f. 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.

17.1.5 <u>GRANULAR ACTIVATED CARBON</u> - See Section under "Filters" for application within filters. Rates of flow shall be consistent with the type and intensity of the problem. The design used must be supported by the results of pilot plant studies when granular activated carbon units are used for organic removal.

17.1.6 <u>COPPER SULFATE AND OTHER COPPER COMPOUNDS</u> - Continuous or periodic treatment of water supplies with copper compounds to kill algae or other growths shall be controlled to prevent copper in excess of 1.0 milligrams per liter as copper in the plant effluent or distribution system. Care shall be taken to assure an even distribution and to prevent fish kills. A dose at 0.9 lb/acre-foot may be considered for waters with alkalinity less than 50 mg/L, and 5.4 lb/acre-foot if alkalinity is greater than 50 mg/L.

17.1.7 <u>AERATION</u> - See appropriate section in this document.

17.1.8 <u>POTASSIUM PERMANGANATE</u> - 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. It must be applied as early in the treatment as possible to provide adequate contact time and must be prior to filtration.

17.1.9 <u>OZONE</u> - Ozonation can be used as a means of taste and odor control. Adequate contact time must be provided to complete the chemical reactions involved. Ozone is generally more desirable for treating water with high threshold odors.

17.1.10 <u>OTHER METHODS</u> - The decision to use any other methods of taste and odor control should be made only after careful laboratory and/or pilot plant tests and on consultation with the Division.

PART 18 - WASTE HANDLING AND DISPOSAL

18.1.0 GENERAL - Provisions must 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 Georgia EPD requirements. In locating waste disposal facilities, due consideration shall be given to preventing potential contamination of the water supply. The quantity of waste produced shall be minimized by choice of treatment processes and chemicals. Although not recommended, if supernatant water from backwash/sludge holding tanks or lagoons is to be recycled through the treatment plant, potential impacts on the treatment process must be considered. Provision of appropriate treatment shall be considered to reduce contaminants that may be concentrated in sludges and backwash water.

18.1.1 SANITARY WASTE - The sanitary waste from water treatment plants, pumping stations, and other waterworks installations must receive treatment. Waste from these facilities must be discharged directly to a sanitary sewer system, when available and feasible, or to an adequate on-site waste disposal facility providing suitable treatment.

18.1.2 BRINE WASTE - The disposal method proposed must receive prior approval from the Division.

18.1.3 LIME SOFTENING SLUDGE - Methods of treatment and disposal of sludge from plants using lime are as follows:

a. Lagoons - Design should provide:

1. Temporary lagoons which must be cleaned periodically should be designed on the basis of 0.7 acres per million gallons per day per 100 milligrams per liter of hardness removed based on a usable lagoon depth of 5 feet. This should provide about 2-1/2 years storage. At least two but preferably more lagoons must be provided in order to give flexibility in operation. An acceptable means of final sludge disposal must be provided. Provisions must be made for convenient cleaning.

2. Permanent lagoons should have a volume of at least 4 times that for temporary lagoons.

3. The design of both temporary lagoons and permanent lagoons should provide for:

(A) location free from flooding;

(B) when necessary, dikes, deflecting gutters or other means of diverting surface water so that it does not flow into the lagoons;

(C) a minimum usable depth of 5 feet;

(D) adequate freeboard of at least 2 feet;

(E) adjustable decanting devices;

(F) effluent sampling point;

(G) adequate safety provisions; and

(H) parallel operation.

b. The application of liquid lime sludge to farm land may be considered as a method of disposal with the prior approval of the Division.

c. 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.

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

e. Disposal at a landfill can be done as either a solid or liquid if the landfill can accept such waste, in conformance with the Division requirements.

f. Mechanical dewatering of sludge may be considered. Pilot studies on a particular plant waste are required.

g. Calcination of sludge may be considered. Pilot studies on a particular plant waste are required.

h. Lime sludge drying beds are not recommended.

18.1.4 ALUM SLUDGE

18.1.4.1 GENERAL

a. 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.

b. Mechanical concentration may be considered. A pilot plant study is required before the design of a mechanical dewatering installation.

c. 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.

d. Alum sludge can be discharged to a sanitary sewer. However, initiation of this practice will depend on obtaining approval from the owner of the sewerage system as well as from the Division before final designs are made.

e. Lagoons should be designed to produce an effluent satisfactory to the Division and should provide for:

   1. location free from flooding;

   2. where necessary, dikes, deflecting gutters or other means of diverting surface water so that it does not flow into the lagoon;

   3. a minimum usable depth of 5 feet;

   4. adequate freeboard of at least 2 feet;

   5. adjustable decanting device;

   6. effluent sampling point; and

   7. adequate safety provisions.

18.1.5 <u>"RED WATER" WASTE</u> - Waste filter wash water from iron and manganese removal plants can be disposed of as follows:

a. <u>SAND FILTERS</u> - Sand filters should have the following features:

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

   2. 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 must be provided to properly dispose of the wash water involved.

3. Sufficient filter surface area should be provided so that, during any one filtration cycle, no more than 2 feet of backwash water will accumulate over the sand surface.

4. The filter shall 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. The filter media should consist of a minimum of 12 inches of sand, 3 to 4 inches of supporting small gravel or torpedo sand, and 9 inches of gravel in graded layers. All sand and gravel should be washed to remove fines.

6. 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 Division.

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

8. Provision shall be made for the sampling of the filter effluent.

9. Overflow devices from "red water" filters shall not be allowed.

10. Where freezing is a problem, provisions should be made for covering the filters during the winter months.

11. "Red water" filters shall comply with the common wall provisions contained in this document, which pertain to the possibility of contaminating treated water with an unsafe water.

b. LAGOONS - Lagoons shall have the following features:

1. be designed with a volume 10 times the total quantity of wash water discharged during any 24-hour period;

2. a minimum usable depth of 3 feet;

3. length 4 times width, and the width at least 3 times the depth, as measured at the operating water level;

4. outlet to be at the end opposite the inlet;

5. a weir overflow device at the outlet end with weir length equal to or greater than depth;

6. velocity to be dissipated at the inlet end.

c. <u>DISCHARGE TO COMMUNITY SANITARY SEWER</u> - Red water can 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 Division before final designs are made. A holding tank is recommended to prevent overloading the sewers.

d. <u>RECYCLING "RED WATER" WASTES</u> - Recycling of supernatant or filtrate from "red water" waste treatment facilities to the head end of an iron removal plant shall not be allowed.

e. <u>WASTE FILTER WASH WATER</u>

1. Waste filter wash water from surface water treatment or lime softening plants should have suspended solids reduced to a level acceptable to the Division in accordance with the issued NPDES permit, before being discharged.

2. The plants should construct appropriate holding tanks or other facilities for this purpose. The holding tank 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.

3. A plant that has two filters should have a holding tank that will contain the total waste wash water from both filters calculated by using a 15 minute wash at 20 gpm/ft^2. In plants with more filters, the size of the holding tank will depend on the anticipated hours of operation.

4. 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.

PART 19 - CHEMICAL APPLICATION

19.1.0 GENERAL - All chemicals that come into contact with the drinking water during its treatment shall be certified for conformance with the NSF Standard 60.

19.1.1 DESCRIPTION: Plans and specifications describing the water treatment plants (new, modified or expanded) shall include the chemicals and chemical feed equipment to be used in the treatment process. Plans and Specifications shall include:

a. descriptions of feed equipment, including maximum and minimum feed ranges;

b. location of feeders, piping layout and points of application;

c. storage and handling facilities;

d. specifications for chemicals to be used;

e. operating and control procedures including proposed application rates; and

f. descriptions of testing equipment and procedures.

19.1.2 CHEMICAL APPLICATION - Chemicals shall be applied to the water at such points and by such means as to:

a. assure maximum efficiency of treatment and good mixing of the chemicals with the water;

b. assure maximum safety to consumer and the operators;

c. provide maximum flexibility of operation through various points of application, when appropriate; and,

d. prevent backflow or back-siphonage at all feed points.

19.1.3 FEED EQUIPMENT

a. Number of Feeders: Where chemical feed is essential for the production of safe drinking water, or necessary for continuous operation and for the protection of the water supply:

1. a minimum of two feeders shall be provided;

2. a standby unit or a combination of units of sufficient capacity should be available to replace the largest unit during shut-downs;

3. where a booster pump is required, duplicate equipment should be provided and, when necessary, a standby power.

b. Additional Considerations: A separate feeder must be used for each chemical applied. In addition, spare parts should be available for all feeders to replace parts which are subject to wear and damage.

19.1.4 GENERAL EQUIPMENT DESIGN AND CAPACITY - General equipment design shall be such that:

a. feeders will be able to supply, at all times, the necessary amounts of chemicals at an accurate rate, throughout the range of feed;

b. feeders are adjustable to handle all plant flow rates;

c. chemical-contact materials and surfaces are resistant to the aggressiveness of the chemical solution;

d. corrosive chemicals are introduced in such a manner as to minimize potential for corrosion;

e. chemicals that are incompatible are not stored or handled together;

f. all chemicals are conducted from the feeder to the point of application in separate conduits;

g. chemical feeders are as near as practical to the feed point;

h. positive displacement type solution feed pumps shall be used to feed liquid chemicals, and shall not be used to feed chemical slurries;

i. chemicals are fed by gravity where practical, and shall not be siphoned into the water supply;

j. service water supply shall be protected from contamination by the chemical solutions. It should be equipped with backflow prevention devices or an air gap should be provided between the supply line and the solution tank;

k. no direct connection shall exist between any sewer and a drain or overflow from the feeder or solution chamber or tank. All drains shall terminate at least six inches or two pipe diameters, whichever is greater, above the overflow rim of a receiving sump, conduit or waste receptacle.

l. Dry Chemical Feeders shall:

(A) measure chemicals volumetrically or gravimetrically;

(B) provide adequate solution water and agitation of the chemical in the solution pot;

(C) provide gravity feed from solution pots; and,

(D) completely enclose chemicals to prevent emission of dust to any of the operating areas.

m. Positive Displacement Solution Pumps shall be used to feed liquid chemicals, but shall not be used to feed chemical slurries. Pumps must be sized to match or exceed maximum head conditions found at the point of injection.

n. 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 providing vacuum relief, or providing a suitable air gap, or other suitable means or combinations as necessary.

19.1.5 <u>LOCATION OF CHEMICAL FEED EQUIPMENT</u> - Chemical feed equipment shall:

a. be located in a separate room to reduce hazards and dust problems;

b. be conveniently located near points of application to minimize length of feed lines;

c. be readily accessible for servicing, repair, calibration and observation of operation;

d. be located such that the flow to the rapid mix is by gravity;

e. shall be located and protective curbing provided (containment), so that chemicals from equipment failure, spillage or accidental drainage shall not enter the water through conduits, treatment or storage basins, or result in hazardous or unpermitted discharge.

19.1.6 <u>FEEDER CONTROLS</u>

a. Feeders may be manually or automatically controlled, with automatic controls being designed so as to allow override by manual controls.

b. Process must be manually started following shutdowns.

c. At automatically operated facilities, chemical feeders shall be electrically interconnected with the well or service pump and should be provided a nonstandard electrical receptacle.

d. Chemical feed rates shall be proportional to flow.

e. A means to measure water flow must be provided in order to determine chemical feed rates.

f. Provisions shall be made for measuring the quantities of chemicals used.

19.1.7 WEIGHING SCALES

a. shall be provided for weighing cylinders, at all plants utilizing chlorine gas;

b. shall be provided to measure fluoride solution feed;

c. should be provided for volumetric dry chemical feeders; and

d. should be accurate to measure increments of 0.5 % of load.

19.1.8 IN-PLANT WATER SUPPLY – Service water supply shall be:

a. only from a safe, approved source. It can be obtained from a location sufficiently downstream of any chemical feed point to assure adequate mixing.

b. ample in quantity and adequate in pressure;

c. provided with means for measurement when preparing specific solution concentrations by dilution;

d. properly treated for hardness, when necessary;

e. properly protected against backflow, by appropriate mean such as:

    1. an air gap between fill pipe and maximum flow line of solution or dissolving tank equivalent to 2 pipe diameters but not less than 6 inches; or

    2. an approved reduced pressure backflow preventer, consistent with the degree of hazard, aggressiveness of chemical solution, back pressure sustained, and available means for maintaining and testing the device; or

    3. a satisfactory vacuum relief device.

f. Where a booster pump is required, duplicate equipment should be provided and, when necessary, standby power.

19.2.0 STORAGE OF CHEMICALS

a. Space should be provided for:

   1. at least 30 days of chemical supply;

   2. convenient and efficient handling of chemicals;

   3. dry storage conditions;

   4. a minimum storage volume of 1-1/2 truck loads where purchase is by truck load lots;

   5. protection against excessive, damaging or dangerous extremes in temperature.

b. Storage tanks and pipelines for liquid chemicals shall be specific to the chemicals and not for alternates.

c. Chemicals shall be stored in covered or unopened shipping containers, unless the chemical is transferred into an approved storage unit.

d. Liquid chemical storage tanks must:

   1. have a liquid level indicator;

   2. have an overflow and a receiving basin or drain capable of receiving accidental spills or overflows;

   3. provide for protection against freezing and/or loss from solution due to temperature drop.

19.2.1 SOLUTION TANKS

a. A means which is consistent with the nature of the chemical solution shall be provided in a solution tank to maintain a uniform strength of solution.

b. Continuous agitation shall be provided to maintain slurries in suspension.

c. Two solution tanks of adequate volume may be required for a chemical to assure continuity of supply in servicing a solution tank.

d. Each tank shall be provided with a drain,

1. No direct connection between any tank or drain and a sewer shall be allowed; and

2. Any drain must terminate at least 2 pipe diameters above the overflow rim of a receiving sump, conduit or waste receptacle.

e. Means shall be provided to indicate the solution level in the tank.

f. Make-up water shall enter the tank above the maximum solution level, providing an air gap of 2 pipe diameters but not less than 6 inches, or shall be protected with an approved backflow prevention devices.

g. Chemical solutions shall be kept covered. Large tanks with access openings shall have such openings curbed and fitted with overhanging covers.

h. Subsurface locations for solution tanks shall:

1. be free from sources of possible contamination; and,

2. assure positive drainage for groundwaters, accumulated water, chemical spills and overflows.

i. Overflow pipes, when provided, should:

1. be turned downward, with the end screened;

2. have a free fall discharge; and

3. be located where noticeable.

j. Acid storage tanks must be vented to the outside atmosphere, but not through vents in common with day tanks.

k. Each tank shall be provided with a valved drain and protected against backflow.

l. Solution tanks shall be located and protective curbings provided so that chemicals from equipment failure, spillage or accidental drainage shall not enter the water in conduits, treatment or storage basins.

19.2.2 <u>DAY TANKS</u>

a. Day tanks shall be provided where bulk storage of liquid chemical is provided.

b. Day tanks should hold no more than a 30 hour supply.

c. 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 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 must be such that unit readings are meaningful in relation to the total amount of chemical fed during a day.

d. 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, must be provided.

e. A means which 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.

f. Tanks shall be properly labeled to designate the chemical contained.

19.3.0 CHEMICAL FEED LINES

a. should be as short as possible, and

   1. of durable, corrosion-resistant material;

   2. easily accessible throughout the entire length;

   3. protected against freezing;

   4. easily cleaned;

   5. lime feed lines should be designed so that they can be easily replaced;

   6. avoid sharp bends when possible.

b. should slope upward from the chemical source to the feeder when conveying gases;

c. should introduce corrosive chemicals in such manner as to minimize potential for corrosion;

d. shall be designed consistent with scale-forming or solids depositing properties of the water, chemical, solution or mixtures conveyed;

e. shall not carry chlorine gas beyond chlorine storage and feeder room(s) except under vacuum;

f. should be color coded.

19.4.0 HANDLING OF CHEMICALS

a. Carts, elevators and other appropriate means shall be provided for lifting chemical containers to minimize excessive lifting by operators.

b. Provisions shall be made for disposing of empty bags, drums or barrels by an approved procedure which will minimize exposure to dusts.

c. Provision must 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 which may enter the room in which the equipment is installed. Control should be provided by use of:

   1. vacuum pneumatic equipment or closed conveyor systems;

   2. facilities for emptying shipping containers in special enclosures; and/or

   3. exhaust fans and dust filters which put the hoppers or bins under negative pressure.

d. Provision shall be made for measuring quantities of chemicals used to prepare feed solutions and for easy calibration of solution pumps measured from the suction side.

e. Storage tanks and pipelines for liquid chemicals shall be specific to the chemicals and not for alternates.

f. Chemicals that are incompatible shall not be fed, stored or handled together.

g. Precautions shall be taken with electrical equipment to prevent explosions, particularly in the use of sodium chlorite and activated carbon.

h. Acids shall be kept in closed, acid resistant shipping containers or storage units. Acids shall not be handled in open vessels, but should be pumped in undiluted form from original containers, through suitable hose, to the point of treatment or to a covered day tank.

19.5.0 HOUSING

a. Structures, rooms and areas accommodating chemical feed equipment shall provide convenient access for servicing, repair and observation of operation.

b. Floor surfaces shall be smooth and impervious, slip-proof and well drained with 2.5 % minimum slope.

c. Vents from feeders, storage facilities and equipment exhaust shall discharge to the outside atmosphere above grade and remote from air intakes.

d. Open basins, tanks and conduits shall be protected from chemical spills or accidental drainage.

19.5.1 <u>CHLORINE GAS FEED AND STORAGE SHALL BE</u>:

a. enclosed and separated from other operating areas in order to prevent injury to personnel and damage to equipment;

b. provided with a shatter resistant inspection window installed in an interior wall, to permit viewing of the interior of the room and equipment;

c. constructed in such a manner that all openings between the chlorine room and the remainder of the plant are sealed;

d. provided with doors equipped with panic hardware, assuring ready means of exit and opening outward only to the building exterior;

e. provided with locks to prevent unauthorized entry;

f. Full and empty cylinders of chlorine gas should be:

1. isolated from operating areas;

2. restrained in position to prevent upset;

3. stored in rooms separate from ammonia storage; and,

4. stored in areas not in direct sunlight or exposed to excessive heat.

g. Where chlorine gas is used, the room shall be constructed to provide the following:

1. each room shall have a ventilating fan with a capacity which provides one complete air change per minute when the room is occupied;

2. the air outlet from the room shall be near the floor level and the point of discharge shall be so located as not to contaminate air inlets to any rooms or structures, or adversely affect the surrounding environment;

3. air inlets should be through louvers near the ceiling, and temperature controlled to prevent adverse affect on chlorinator;

4. louvers for chlorine room air intake and exhaust fan shall facilitate airtight closure;

5. separate switches for the fan and lights shall be located outside of the chlorine room, at the entrance. The exhaust fan should automatically be activated when the door is opened. 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;

6. vents from feeders and storage shall discharge to the outside atmosphere, above grade;

7. the room location should be on the prevailing downwind side of the building away from entrances, windows, louvers, walkways, etc.;

8. 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;

9. Chlorinator rooms should be heated to 60^0 F, but should be protected from excessive heat. Cylinders and gas lines should be protected from temperatures above that of the feed equipment;

10. Pressurized chlorine feed lines shall not carry chlorine gas beyond the chlorinator room;

11. Gaseous feed chlorine installations shall be equipped with a gas detection device connected to an audible alarm to prevent undetected potentially dangerous leakage of chlorine gas.

19.6.0 SPECIAL PRECAUTIONS MUST BE TAKEN WITH:

a. Acids and Caustics

1. Acids and caustics shall be kept in closed corrosion-resistant shipping containers or storage units.

2. Acids and caustics shall not be handled in open vessels, but should be pumped in undiluted form from original containers through suitable hose, to the point of treatment or to day tanks.

3. Acid storage tanks must be vented to the outside atmosphere, but not through vents in common with day tanks.

4. Liquid caustic (50% sodium hydroxide solution) which is hazardous and may be lost from solution at low temperatures.

b. <u>Sodium Chlorite for Chlorine Dioxide Generation</u>: For Sodium Chlorite in chlorine dioxide generation, provisions shall be made for proper storage and handling of sodium chlorite to eliminate any danger of explosion.

1. <u>Storage</u>

(A) 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 must be stored away from organic materials which would react violently with sodium chlorite.

(B) The storage structures shall be constructed of noncombustible materials.

(C) If the storage structure must be located in an area where a fire may occur, water must be available to keep the sodium chlorite area cool enough to prevent decomposition from heat and the resultant explosive conditions.

2. <u>Handling</u>

(A) Care should be taken to prevent spillage.

(B) An emergency plan of operation should be available for the clean up of any spillage.

(C) Storage drums must be thoroughly flushed prior to recycling or disposal.

3. <u>Feeders</u>

(A) Positive displacement feeders shall be provided.

(B) Tubing for conveying sodium chlorite or chlorine dioxide solutions shall be Type 1 PVC, polyethylene or materials recommended by the manufacturer.

(C) Chemical feeders may be installed in chlorine rooms if sufficient space is provided or facilities meeting the requirements stated in this document shall be provided.

(D) Feed lines shall be installed in a manner to prevent formation of gas pockets and shall terminate at a point of positive pressure.

(E) Check valves shall be provided to prevent the backflow of chlorine into the sodium chlorite line.

c. Activated Carbon: 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.

d. Calcium Hypochlorite and Potassium Permanganate: Calcium hypochlorite and potassium permanganate, which may ignite spontaneously on contact with combustible substances.

e. Hydrofluosilicic Acid: Hydrofluosilicic acid, which is extremely corrosive. Fumes or spillage may damage equipment or structures.

19.6.0 CHEMICALS

a. Chemical containers shall be fully labeled to include:

   1. chemical name, purity and concentration;

   2. supplier name and address; and,

   3. expiration date where applicable.

b. Chemicals shall be listed as meeting NSF Standard 60 and shall meet AWWA specifications, where applicable.

c. Provisions should be made for assay of chemicals delivered.

d. Chemicals shall not impart any toxic material to the water under recommended dosages.

19.7.0 OPERATOR SAFETY

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

b. Special provisions shall be made for ventilation of chlorine feed and storage rooms. See the applicable section in this document.

c. Respiratory protection equipment, meeting the requirements of the National Institute for Occupational Safety and Health (NIOSH) shall be available where chlorine gas is handled. It shall be stored at a convenient location that is easily accessible to the operator, but not inside any room where chlorine is used or stored. The units shall use compressed air and have at least a 30 minute capacity. Provision of a 30 minute backup cylinder is urged to prevent loss of utility while the primary air cylinder is being refilled or tested. It is preferred that the unit be compatible with or exactly the same as units used by the fire department responsible for the plant.

d. A bottle of ammonium hydroxide, 56 % ammonia solution, shall be available for chlorine leak detection.

e. Although the gaseous feed chlorine installations should be provided with appropriate leak repair kits, where ton containers are used, a leak repair kit approved by the Chlorine Institute must 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.

f. At least one pair of rubber gloves, a dust respirator of a type certified by NIOSH for toxic dusts, an apron or other protective clothing like rubber boots and goggles or face mask shall be provided for each operator in any shift who will handle dry chemicals, preparing chemical solutions, or cleaning up spills.

g. A deluge shower and/or eyewashing 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 should be installed in the water line feeding the deluge shower and eyewashing device, as necessary.

h. Other protective equipment and facilities should be provided as necessary.

PART 20 - LABORATORY FACILITIES

20.1.0 GENERAL

a. Laboratory equipment and facilities shall be compatible with the raw water source, intended design of the treatment plant, daily monitoring and the complexity of the treatment process involved.

b. Recognized laboratory procedures must be utilized and the testing equipment shall be acceptable to the Division.

c. Laboratory facilities and any other part of the water treatment plant should not be used for activities and/or purposes that are not pertinent to the operation of the plant or in the execution of the duties of the operator and/or the laboratory analyst.

20.1.1 LABORATORY SPACE AND FACILITIES

a. Laboratory facilities shall be located in a separate room from office/lunch activities and from the treatment units. Facilities shall be isolated by doors and not be located in the main traffic pattern.

b. Sufficient bench space, adequate ventilation, adequate lighting, storage room, laboratory sink, and auxiliary facilities shall be provided.

c. The bacteriological laboratory, if provided, shall be acceptable to the Division. It shall have adequate counter space and shall be located in a separate room or area.

20.1.2 SAMPLE TAPS - Sample taps shall be provided so that water samples can be obtained from each water source and from appropriate locations in each unit operation of treatment. Taps shall be consistent with sampling needs and not be of petcock type. Sample lines and pumps where applicable shall be sized to minimize time lag between point of sampling and point of sample collection.

20.1.3 RECORDS MAINTENANCE

20.1.3.1 GENERAL - Daily records of the operation of the water treatment facility and water distribution system, including the amount of water treated daily, results of the performance of daily tests pertinent to the control of the water treatment processes, jar tests, disinfectant residuals, tests performed in the water distribution system, and any test results and records as may be required by the Division shall be maintained by the water supplier. These records shall be kept on the premises or at a convenient location near the water plant.

20.1.3.2 RECORDS MAINTENANCE DURATION

a. Microbiological: Records of microbiological analyses shall be kept for not less than five (5) years.

b. Chemicals: Records of chemical analyses shall be kept for not less than ten (10) years.

c. Lead/ Copper: Original records of all lead and copper sampling data, analyses, reports, surveys, letters, evaluations, schedules, Division determinations, and any other related information shall be kept for not less than twelve (12) years.

d. Individual Filter Monitoring: Records of individual filter monitoring results that are taken under Rules for Safe Drinking Water, Chapter 391-3-5-.20(9)(c) shall be maintained for at least three (3) years.

e. Violations: Records of action taken by the system to correct violations of the Rules for Safe Drinking Water, Chapter 391-3-5, shall be kept for a period of not less than three (3) years after the last action taken with respect to the particular violation.

f. Inspections/Sanitary Survey Reports: Copies of any written reports, summaries or communications relating to sanitary surveys of the system conducted by the system itself, by a private consultant, or by any local, state or federal agency, shall be kept for a period not less than ten (10) years after completion of the sanitary survey involved.

g. Variance/ Exemption: Records concerning a variance or exemption granted to the system shall be kept for a period ending not less than five (5) years following the expiration of such variance or exemption.

- END –