



CIRCULAR DEQ 3

**STANDARDS
FOR
SMALL WATER SYSTEMS**

2018 EDITION

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CHAPTER 1 - SUBMISSION OF PLANS

1.0 GENERAL

All reports, final plans, and specifications must be submitted at least 60 days prior to the date on which action by MDEQ is desired. The term "MDEQ," as used in this circular, refers to the Montana Department of Environmental Quality or a delegated division of local government. Environmental assessments and permits for construction, to take water, for waste discharges, for stream crossings, etc., may be required from other federal, state, or local agencies. No approval for construction can be issued until final, complete, and detailed plans and specifications have been submitted to MDEQ and found to be satisfactory. Three copies of the final plans and specifications must be submitted. An approved set will be returned to the applicant. Documents submitted for formal approval must include, but are not limited to, the following:

- a. design report;
- b. a summary of the design criteria;
- c. operation requirements, where applicable;
- d. general layout;
- e. detailed plans;
- f. specifications;
- g. for public water systems, documentation that owner is committed to providing as-built drawings of the project and the certification letter required in ARM 17.38.101;
- h. for new public nontransient, noncommunity systems, the technical, financial, and managerial information required in Department Circular DEQ-1, Standard 1.0.h and Appendix A; and
- i. review fees as specified in ARM 17.38.106.

1.1 DESIGN REPORT

The design report for new water works must present the following information. The design report for existing water systems must present the following information to the extent it applies to the water system improvements:

1.1.1 General information, including:

- a. a description of the existing water works and sewage facilities;
- b. an identification of the municipality or area served; and
- c. the name and mailing address of the owner, developer, and official custodian.

1.1.2 Extent of water system, including:

- a. description of the nature and extent of the area or facility to be served;
- b. provisions for extending the water works system to include additional facilities; and
- c. appraisal of the future requirements for service, including existing and potential water supply needs.

1.1.3 Alternate Plans

Where two or more solutions exist for providing water supply facilities, each of which is feasible and practicable, discuss the alternate plans and give reasons for selecting the one recommended, including financial considerations.

1.1.4 Water use data, including:

- a. the estimated population, which will be served by the proposed water supply system or expanded system;
- b. present water consumption, if available, and the projected average and maximum daily demands or peak instantaneous demand where appropriate used as the basis of design, including fire flow demand, if provided; and
- c. present and/or estimated yield of the sources of supply.

1.1.5 Flow requirements, including:

- a. hydraulic analyses based on flow demands and pressure requirements (See Section 8.2.1); and
- b. fire flows, when fire protection is provided, meeting the recommendations of the fire protection agency in which the water system is being developed, or in the absence of such a recommendation, the fire code adopted by the State of Montana. Documentation from the fire protection agency may be required if the flow requirements vary significantly from typical values.

1.1.6 Sources of water supply

Describe the proposed source or sources of water supply to be developed, including:

- a. sites considered;
- b. advantages of the site selected;
- c. elevations with respect to surroundings;
- d. sources of possible contamination such as sewers and sewage treatment/disposal facilities, highways, railroads, landfills, outcroppings of consolidated water-bearing formations, storm water facilities, chemical facilities, waste disposal wells, agricultural uses, etc.;

- e. a preliminary assessment for proposed ground water sources that may be under the direct influence of surface water prepared in accordance with Department Circular PWS-5, "Assessment of Ground Water Sources Under the Direct Influence of Surface Water;" and
- f. a source water assessment report prepared in accordance with Department Circular PWS-6.

1.1.7 Sewage system available

Describe the existing or proposed sewage collection system and sewage treatment works, with special reference to their relationship to existing or proposed water works structures, which may affect the operation of the water supply system or which may affect the quality of the supply.

1.2 PLANS

Plans for water works improvements must be legible and must provide the following:

1.2.1 General layout including:

- a. suitable title;
- b. name of entity or person responsible for the water supply;
- c. area or facility to be served;
- d. scale, in feet;
- e. north point;
- f. date and name of the designer; and
- g. location, nature, and size of existing water facilities, if any.

1.2.2 Detailed plans, including:

- a. arrangement of present or planned wells or structures;
- b. plan and profile drawings of well construction showing diameter and depth of drill holes, casing and liner diameters and depths, grouting depths, elevations and designation of geological formations, water levels, and other details to describe the proposed well completely;
- c. location of all existing and potential sources of pollution, which may affect the water source or underground treated water storage facilities, including all sewage lagoons with the design high water mark within 1,000 feet of the well site;

- d. location, size, and length of existing or proposed streets; water sources, including ponds, lakes, and drains; storm, sanitary, combined, and house sewers; septic tanks, disposal fields, and cesspools; and abandoned wells;
- e. piping in sufficient detail to show flow through the water system, including waste lines;
- f. locations, dimensions, and elevations of all proposed water system facilities;
- g. locations of sampling taps; and
- h. adequate description of any features not otherwise covered by the specifications.

1.3 SPECIFICATIONS

Complete and detailed technical specifications must be supplied for the proposed project.

1.4 DEVIATIONS FROM STANDARDS

Deviations from the mandatory requirements of these standards may be granted by MDEQ on a case-by-case basis for specific projects.

1.4.1 Procedure

- a. A person desiring a deviation must make a request in writing on the *Department of Environmental Quality Deviation Form*. The request must identify the specific section and deviation of the standards to be considered. Adequate justification for the deviation must be provided. "Engineering judgment" or "professional opinion" without supporting data is not considered adequate justification.
- b. A panel of three persons from MDEQ shall review the request and make a final determination on whether a deviation may be granted.
- c. A file of all deviations will be maintained by MDEQ.
- d. Deviations to the standards will not be approved if they would cause a violation of a statute or administrative rule.

CHAPTER 2 - GENERAL DESIGN CONSIDERATIONS

2.0 DISINFECTION

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

2.1 SAMPLE TAPS

Sample taps must be provided for public water systems so that water samples can be obtained from each water source. Taps must be consistent with sampling needs and may not be of the petcock type. Taps used for obtaining samples for bacteriological analyses must be of the smooth-nosed type without interior or exterior threads, may not be of the mixing type, and may not have a screen, aerator, or other such appurtenance.

2.2 OTHER CONSIDERATIONS

Consideration must be given to the design requirements of other federal, state, and local regulatory agencies for items such as safety requirements, special designs for the handicapped, plumbing and electrical codes, construction in the flood plain, etc. All equipment must be designed to operate within manufacturer's recommended range.

2.3 CHEMICALS AND WATER CONTACT MATERIALS

Chemicals and water contact materials must be approved by MDEQ or meet the appropriate ANSI/AWWA or ANSI/NSF standards.

2.4 SECURITY

To deter unauthorized access and malevolent acts, security measures should be considered. Such measures, at a minimum, should include means to lock all exterior doorways, windows, gates, and other entrances to treatment and storage facilities. All access points to source components must be locked and secure, including well caps, which must have a lockable cap or a secure measure of locking the cap to the casing without compromising the sanitary seal. An alternative to securing the cap would be to have the well head located in a secure and fenced area. Other security measures, based on threat and vulnerability of specific components, should be evaluated and addressed through methods which include fencing, signage, closed-circuit monitoring, real-time water quality monitoring, intrusion alarms, lighting, cyber protection of SCADA controls, and protective environmental features. See Security Policy in Department Circular DEQ-1 for additional guidance.

CHAPTER 3 - SOURCE DEVELOPMENT

3.0 GENERAL

In selecting the source of water to be developed, the designer must demonstrate, to the satisfaction of MDEQ, that an adequate quantity of water will be available and that the water delivered to the consumers meet the current requirements of MDEQ.

3.1 SURFACE WATER

Surface water sources must comply with the applicable sections of Department Circular DEQ-1, Standards for Water Works, including Section 3.1.

3.2 GROUND WATER

A ground water source includes all water from dug, drilled, bored, or driven wells and infiltration lines. Prior to construction of a well intended to serve a public water supply, the proposed location and the plans and specifications must be approved by MDEQ in accordance with the requirements of this section. In order to assess the available water quality and quantity, MDEQ may require construction and testing of the well in accordance with the approved plans and specifications and at the approved location prior to approval of other system components. All wells must be constructed by a licensed water well contractor in accordance with Title 37, Chapter 43, MCA, and ARM Title 36, chapter 21 current edition, (Water Well Contractor rules) with the following additional requirements.

3.2.1. Quantity

3.2.1.1 Source capacity

The total developed ground water source capacity must equal or exceed the design maximum day demand. Adequate storage per Department Circular DEQ-1 Section 7.0.1 will be required if source capacity is inadequate to meet peak instantaneous demand.

3.2.1.2 Water use estimates for design purposes

- a. Domestic use - 100 gpcd must be provided for average domestic use unless the designer has sufficient data, acceptable to MDEQ, to show a lesser quantity to be adequate.
- b. Commercial/industrial use – for non-residential public water systems, the system must be capable of meeting peak demands. This is typically calculated from a fixture unit analysis per the UPC, AWWA Fixture Value Method, or by applying a peaking factor to the average day demand in gallons per minute or other means acceptable to MDEQ.
- c. Irrigation - when irrigation water is provided, information must be submitted to MDEQ to show that adequate water will be available. Such information must include:
 1. the area to be irrigated in acres or square feet;
 2. water requirements in inches/week; and
 3. proposed methods of controlling irrigation beyond the capacity of the system.

- d. Fire flows - fire flows must meet the recommendations of the agency in which the water system is being developed or, in the absence of such a recommendation, the fire code adopted by the State of Montana.

3.2.2. Quality

MDEQ shall determine the minimum treatment required for a ground water source serving a public water supply to ensure compliance with ARM Title 17, chapter 38, subchapter 2.

3.2.2.1 Microbiological quality

- a. Disinfection of every new, modified, or reconditioned ground water source must be provided in accordance with ARM 36.21.662(1) prior to and after placement of permanent pumping equipment.
- b. More than 72 hours after disinfection, two or more water samples must be submitted to a laboratory certified by the Department of Public Health and Human Services for microbiological analysis with satisfactory results reported to MDEQ prior to placing the well into service.
- c. If MDEQ determines, from the required application materials, that the source may be ground water under the direct influence of surface water in accordance with Department Circular PWS-5, then further assessment or treatment may be required.

3.2.2.2 Physical and chemical quality

- a. Every new, modified, or reconditioned ground water source must be examined for applicable physical and chemical characteristics by tests of representative samples in laboratories certified by the Department of Public Health and Human Services, with the results reported to MDEQ.
 - 1. Testing must include nitrate/nitrite and total dissolved solids or conductivity as a minimum for multi-user non-public systems and transient noncommunity public water systems. Additional testing may be required for other parameters where MDEQ has information suggesting they may be present in harmful quantities or where additional regulatory requirements apply.
 - 2. Testing must include the constituents of ARM 17.38.216 for nontransient noncommunity public water systems.
 - 3. The above testing may be waived where information submitted confirms water quality will be acceptable.
- b. Samples must be collected and analyzed at the conclusion of the test pumping procedure prior to disinfection. MDEQ may require sample results to be submitted to MDEQ for review and approval to demonstrate conformance with ARM Title 17, chapter 38, subchapter 2, prior to use of a new source or construction of a new system.

3.2.3 Location

3.2.3.1 Well location

Regarding a proposed well location, MDEQ must be consulted prior to design and construction as the location relates to required separation between existing and potential sources of contamination and ground water development. Wells must be located at least 100 feet from sewer lines, septic tanks, holding tanks, and any other structures used to convey or retain industrial, storm, or sanitary waste and state or federal highway rights-of-way. Wells must meet the setback distance to sewage lagoon established in ARM 17.30.1702. Well location(s) must be based on a source water delineation and assessment conducted in accordance with Section 1.1.6 of this circular.

3.2.3.2 Continued protection

Continued protection of the well site from potential sources of contamination must be provided either through zoning, easements, deed notices, leasing, or other means acceptable to MDEQ. Easements and deed notices must be filed with the County Clerk and Records Office. Such protection must extend for at least a 100-foot radius around the well (well isolation zone). In addition, separation distances between proposed wells and potential sources of contamination must be defined and justified by the applicant in accordance with Section 1.1.6 of this circular. The well isolation zone of a proposed or existing well may not be in a ground water mixing zone as defined in ARM 17.30.517 and also may not include easements that would conflict with the proposed use. Fencing of the site may be required by MDEQ.

3.2.4 Testing and Records

3.2.4.1 Yield and drawdown tests

- a. A test must be performed on every production well after construction or subsequent treatment and prior to placement of the permanent pump.
- b. The test methods must be clearly indicated in specifications.
- c. The test pump must have a capacity, at maximum anticipated drawdown, at least equal to the quantity required under Section 3.2.4.1.d.
- d. The test must provide for continuous constant rate pumping at either:
 1. 1.5 times the design pump capacity for at least 24 hours; or
 2. 1.0 times the design pump capacity for at least 72 hours.
- e. Data of the following at one-hour intervals or less as may be required by MDEQ:
 1. pumping rate;
 2. pumping water levels;
 3. static water level;
 4. water recovery rate and levels; and

5. time of starting and ending each test cycle.
- f. Data collection must begin at time zero. The test may be terminated if stabilized drawdown occurs for at least eight hours during the test. Stabilized drawdown is defined as a water level that does not fluctuate plus or minus 0.5 feet for every 100 feet of drawdown at the design pumping rate. When sufficient historical information is available, a step drawdown test may be approved by MDEQ.

3.2.4.2 Results must be reported electronically to MDEQ on Aquifer Test Data Form 633.

3.2.4.3 Geological data must be determined in accordance with ARM 36.21.667. A copy of the well log must be submitted to MDEQ. For public water supply systems, an accurate geological location, such as latitude and longitude or GIS coordinates as determined by GPS to an accuracy of +/- 25 feet, must be provided.

3.2.5 General well construction

3.2.5.1 Minimum protected depths for public water systems

- a. Minimum protected depths of drilled wells must provide watertight construction to such depth as may be required by MDEQ to:
 1. exclude contamination; and
 2. seal off zones that are, or may be, contaminated or yield undesirable water.
- b. Wells must have unperforated casing to a minimum depth of 25 feet or full-time microbial treatment must be provided.
- c. Full-time microbial treatment is required where the water source is an aquifer with a seasonally high static water level that is within 25 feet of ground surface.
- d. Microbial treatment required under a. or b. must provide 4-log inactivation and/or removal of viruses. A deviation of this standard may be granted by MDEQ in accordance with the procedures of Section 1.7 if the applicant shows there are no existing or approved sources of viral or bacterial contamination from human or animal waste within the 200-day time-of-travel zone of influence for the well and that new sources of contamination will not be introduced for this 200-day time-of-travel zone.
- e. If the water source is from a confined aquifer, microbial treatment is not required. The applicant must demonstrate that an aquifer is confined and the well casing is effectively sealed into a confining unit using the methods outlined in the *Nondegradation Guidance Manual, Appendix M*.

3.2.5.2 Permanent steel casing pipe must:

- a. be in accordance with ARM 36.21.640;
- b. when driven, be equipped with a drive shoe in accordance with ARM 36.21.644; and
- c. have joints in accordance with ARM 36.21.642.

3.2.5.3 Nonferrous casing materials

Plastic well casing must be in accordance with ARM 36.21.645 and 36.21.646.

3.2.5.4 Packers

Packers must be of material that will not impart taste, odor, toxic substance, or bacterial contamination to the well water. Lead packers must not be used.

3.2.5.5 Grouting requirements

- a. For multiple-user water systems, all permanent well casing must be sealed in accordance with ARM 36.21.654 through 36.21.660. The casing must be provided with centralizers in accordance with ARM 36.21.649.
- b. For public water systems
 1. All permanent well casing must be surrounded by a minimum of 1.5 inches of grout around the outside of the casing. The grout must extend to at least 25 feet below ground surface or as specified in Standard 3.2.6 for special aquifer types. Grout may be cement/sand, bentonite chips or pellets, or neat cement. Grout may be applied by gravity into an annular space where chips or pellets are used or by tremie pipe or other conductor from the bottom up. Bentonite must be applied per the manufacturer's instructions. Where casing centralizers preclude the use of chips a high-solids bentonite-sand slurry, cement, or neat cement should be used.
 2. Application
 - a. Sufficient annular opening must be provided to permit a minimum of 1.5 inches of grout around permanent casings, including couplings.
 - b. Prior to grouting through creviced or fractured formations, bentonite or similar materials may be added to the annular opening in the manner indicated for grouting.
 - c. After cement grouting is applied, work on the well must be discontinued until the cement or concrete grout has properly set in accordance with ARM 36.21.654 (1)(d).
 - d. Grout placement must be sufficient to achieve proper density or percent solids throughout the annular space and must be applied in accordance with ARM 36.21.634.
 - e. The type of grout, quantity, and method of placement must be reported on the well log.

3.2.5.6 Upper terminal well construction.

- a. Permanent casing for all ground water sources must be in accordance with ARM 36.21.647.
- b. Where a well house is constructed, the floor surface must be at least six inches above the final ground elevation.
- c. Sites subject to flooding must be provided with an earth mound surrounding the casing and terminating at an elevation at least two feet above the 100-year flood level or highest known flood elevation.
- d. The top of the well casing at sites subject to flooding must terminate at least three feet above the 100-year flood level or highest known flood elevation.
- e. Protection from physical damage and tampering must be provided.
- f. The upper terminal must be constructed to prevent contamination from entering the well.
- g. Where well appurtenances protrude through the upper terminal, the connections to the upper terminus must be mechanical or welded connections that are watertight.

3.2.5.7 Development

Every well must be developed in accordance with ARM 36.21.653. The method of well development must be described on the well log.

3.2.5.8 Capping requirements

Temporary capping requirements must be in accordance with ARM 36.21.661.

3.2.5.9 Well abandonment

All wells that have no further use must be abandoned in accordance with ARM 36.21.670 through 36.21.678.

3.2.6 Aquifer types and construction methods - special conditions

The following special aquifer types and construction methods must be reviewed by MDEQ on a case-by-case basis to assure proper design and protection of public health:

- a. sand or gravel wells;
- b. gravel pack wells;
- c. radial wells;
- d. infiltration lines;
- e. dug wells; and
- f. limestone or sandstone wells.

3.2.6.1 Consolidated formations

- a. In drilled wells that penetrate an aquifer either within a consolidated or confining formation, sealing of the casing must conform with one of the following procedures:
 1. An upper drill hole, at least three inches greater in diameter than the nominal size of the permanent well casing, must extend from land surface to at least three feet into sound, consolidated formation. In no instance must said upper drill hole extend less than 25 feet below land surface; and
 2. An unperforated permanent casing must be installed to extend to this same depth and the lower part of the casing must be sealed into the rock formation with cement grout. The remainder of the annular space to land surface must be filled with an appropriate sealing material.
- b. If temporary surface casing is used in either of the above procedures, this casing must be of sufficient diameter to conform to the upper drill hole specifications. Withdrawal of the temporary casing must take place simultaneously with proper sealing of the annular space to land surface.

3.2.6.2 Unconsolidated formations without significant clay beds

- a. In drilled wells that penetrate an aquifer overlain by unconsolidated formations such as sand and gravel without significant clay beds, an unperforated well casing must extend to at least one foot below the known seasonal low water table. An upper drill hole having a diameter at least three inches greater than the nominal size of the permanent casing must extend to at least 25 feet below land surface.
- b. The annular space between the upper drill hole and the well casing must be kept at least one-half full with bentonite slurry throughout the driving of the permanent casing into the aquifer. After the permanent casing is set in its final position, the remaining annular space must be filled to land surface with appropriate sealing material.
- c. If the oversized drill hole is extended to the same depth as the permanent casing, a suitable bridge must be installed between the casing and the drill hole at a position directly above the production aquifer. The remaining annular space must be completely filled and sealed to land surface with appropriate sealing material.
- d. A suitable bridge is one that prevents the sealing material from dropping into the producing formations and reducing the output of the well.
- e. If temporary casing is used to maintain the oversized drill hole, the annular space must be kept full with appropriate sealing material as the temporary casing is being withdrawn.

3.2.6.3 Unconsolidated formations with clay beds

In drilled wells that penetrate an aquifer overlain by clay or other unconsolidated deposits such as sand and gravel in which significant (at least six feet thick) interbeds of clay are present, the well casing must be terminated in such clay strata, provided that the casing be sealed in substantially the same manner as is required in the case of consolidated formations.

3.2.6.4. Flowing wells

- a. When flowing water is encountered in the well, an unperforated well casing must extend into the confining stratum overlying the artesian zone. The casing must be adequately sealed into the confining stratum so as to prevent surface and subsurface leakage from the artesian zone.
- b. If the well flows at land surface, it must be equipped with a control valve so that the flow can be completely stopped.
- c. The well must be completed with packers or appropriate sealing material that will eliminate leakage around the well casing.

3.2.7 Well pumps, discharge piping and appurtenances

3.2.7.1 Submersible pumps:

Where a submersible pump is used, the top of the casing must be effectively sealed against the entry of water under all conditions of vibration or movement of conductors or cables.

3.2.7.2 Discharge piping

- a. The discharge piping and appurtenances must:
 1. be designed to minimize friction loss;
 2. have control valves and appurtenances located above the pumphouse floor when an above ground discharge is provided;
 3. be protected against the entry of contamination;
 4. be equipped with a check valve (in or at the well), a shutoff valve, a pressure gauge, and a smooth-nosed sampling tap located at a point where positive pressure is maintained;
 5. be equipped with a smooth-nosed sampling tap located at a point where positive pressure is maintained, but before any treatment chemicals are applied. The sample tap must be at least 18 inches above the floor to facilitate sample collection;
 6. where applicable, be equipped with an air 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. Air release vacuum relief valves located in valve pits must meet the relief valve piping requirements in Department Circular DEQ-1, Section 8.5.2;
 7. be valved to permit test pumping and control of each well;
 8. have all exposed piping, valves, and appurtenances protected against physical damage and freezing; and

9. be constructed so that it can be disconnected from the well or well pump to allow the well pump to be pulled.
- b. The discharge piping must be provided with a means of pumping to waste, but may not be directly connected to a sewer.

3.2.7.3 Casing vent

- a. Provisions must be made for venting the well casing to the atmosphere. Venting must be provided by a factory-manufactured vented well cap or fabricated vent assembly. All vents must be screened with corrosion-resistant material to prevent entry of insects and oriented to prevent entry of rainwater.
- b. Fabricated vents must terminate in a down-turned position, at or above the top of the casing or pitless unit in a minimum 1.5-inch diameter opening covered with a 24-mesh screen. The pipe connecting the casing to the vent must be of adequate size to provide rapid venting of the casing. Fabricated vent assemblies must be of such design and strength as to be vandal resistant.

3.2.7.4 Water level measurement

- a. Provisions (i.e. probe access tube or air line) should be made for periodic measurement of water levels in the completed well.
- b. Where pneumatic water level measuring equipment is used, it must be made using corrosion-resistant materials attached firmly to the drop pipe or pump column and in such a manner as to prevent entry of foreign materials.

3.3 SPRINGS

Springs must be designed in accordance with Department Circular DEQ-10.

3.4 CISTERNS

Hauled water cisterns must be designed in accordance with Department Circular DEQ-16.

CHAPTER 4 - TREATMENT

4.0 GENERAL

The need for and design of treatment processes and devices will depend on evaluation of the nature and quality of the water to be treated and the desired quality of the finished water. In accordance with ARM 17.38.101, treatment processes or equipment used for compliance with Maximum Contaminant Levels (MCL) or for disinfection of public water systems are required to be designed by a registered professional engineer. Treatment processes for noncommunity systems installed for reasons other than MCL compliance or disinfection are not required to be designed by a professional engineer if the following conditions are met:

- a. chemicals must meet NSF Standard 60;
- b. equipment components meet NSF Standard 61; and
- c. all cross-connection hazards are eliminated in accordance with the requirements of ARM 17.38.300 through 17.38.312.

4.1 DISINFECTION

Disinfection of noncommunity systems that do not have confirmed source water pathogens may follow the standard below in lieu of those listed in Department Circular DEQ-1.

4.1.1 Minimum treatment

- a. Systems that are required to provide treatment under Standard 3.2.5.1, the ground water rule, or have other indicators of potential viral contamination must provide adequate treatment to ensure 4-log virus inactivation and/or removal. Contact time must be based on tables in Appendix E of the EPA document, "Guidance Manual for Compliance with the Filtration and Disinfection Requirements for Public Water Systems Using Surface Water Sources," March 1991 edition. Baffling factors must be determined in accordance with Appendix C of the EPA document, "Guidance Manual for Compliance with the Filtration and Disinfection Requirements for Public Water Systems Using Surface Water Sources," March 1991 edition.
- b. Systems that have nuisance bacteria in distribution must provide adequate disinfection to ensure that a minimum chlorine residual of 0.2 mg/l can be met at the furthest extent of the distribution system. No minimum contact time is required.

4.1.2 Raw Water Quality

Estimates of chlorine demand must be provided and dose calculations adjusted for the following:

1. Iron;
2. Manganese;
3. Hydrogen Sulfide;
4. Nitrite;
5. Ammonia;
6. Organic Nitrogen; and

7. Total Organic Carbon.

To limit precipitation and objectionable water quality, the need for pretreatment must be addressed where the following levels are exceeded:

1. Iron > 0.3 mg/L; and
2. Manganese > 0.05 mg/L.

4.1.3 Chlorinator Capacity

The chlorinator capacity must be able to maintain the minimum required chlorine residual in the water, as estimated under Section 4.3.1, when maximum flow rate coincides with anticipated maximum chlorine demand. It is recommended that the chlorinator have sufficient capacity to maintain a free chlorine residual of 2 mg/l.

4.1.4 Testing equipment

Chlorine residual test equipment, recognized in the latest edition of "Standard Methods for Examination of Water and Wastewater," must be provided and must be capable of measuring residuals to the nearest 0.1 mg/L. All systems must use the DPD colorimetric method or amperometric titration. It is recommended that systems using the DPD method have a digital readout and self-contained light source.

4.1.5 Specifications

Chlorine liquid, powder, or pellets must meet AWWA standards and ANSI/NSF Standard 60.

4.1.6 Protective equipment

- a. Protective equipment as required by OSHA regulations must be provided.
- b. An eye washing device meeting ANSI Z358.1 must be provided.

4.2 LIQUID HYPOCHLORINATORS

- a. Positive displacement type solution feed pumps must be provided.
- b. Pumps must be capable of operating at the required maximum rate against the maximum head conditions found at the point of injection.
- c. To avoid air locking, small diameter suction lines must be used with foot valves and degassing pump heads.
- d. A flooded suction line should be considered for all positive displacement pumps.

4.2.1 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. If a variable frequency drive well pump is used, the chlorine dose must be proportional to flow.

4.2.2 Pipe material

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.

4.2.3 Siphon control

Liquid chemical feeders must be such that chemical solutions cannot be siphoned into the water supply by:

- a. assuring discharge at a point of positive pressure;
- b. providing vacuum relief;
- c. providing a suitable air gap or anti-siphon device; or
- d. other suitable means or combinations as necessary.

4.2.4 Liquid chemical storage tanks must:

- a. have a liquid level indicator;
- b. have an overflow and a receiving basin or drain capable of receiving accidental spills or overflows without uncontrolled discharge. A common receiving basin may be provided for each group of compatible chemicals that provides sufficient containment volume to prevent accidental discharge in the event of failure of the largest tank;
- c. have ventilation that discharges to the outside atmosphere above grade and remote from air intakes;
- d. must be stored in compatible liquid storage tanks or the original shipping containers; and
- e. reusable sodium hypochlorite storage containers must be reserved for use with sodium hypochlorite only and must not be rinsed out or otherwise exposed to internal contamination.

4.2.5 General equipment design

The general equipment design must be such that:

- a. feeders will be able to supply the necessary amounts of chemicals at an accurate rate throughout the range of feed at all times;
- b. chemical-contact materials and surfaces are resistant to the aggressiveness of the chemical solution;
- c. corrosive chemicals are introduced in such a manner as to minimize potential for corrosion;
- d. chemicals that are incompatible are not stored or handled together;

- e. all chemicals are conducted from the feeder to the point of application in separate conduits;
- f. chemical feeders are as near as practical to the feed point;
- g. chemical feeders and pumps operate at no lower than 20 percent of the feed range unless two fully-independent adjustment mechanisms, such as pump pulse rate and stroke length, are fitted when the pump operates at no less than 10 percent of the rated maximum; and
- h. gravity may be used where practical.

4.3 WELLHEAD PELLETT CHLORINATORS

Wellhead pellet chlorinators must be installed in accordance with manufacturer recommendations and must have a frost-free hydrant or other means of evacuating the well volume to ensure source water samples may be collected. Frost-free hydrants should be located more than 25 feet from the wellhead. Consideration should be given to lining of the well casing if iron precipitation is expected.

CHAPTER 5 - CHEMICAL APPLICATION

5.0 GENERAL

In accordance with ARM 17.38.101, treatment processes or equipment used for compliance with Maximum Contaminant Levels (MCL) or for disinfection of public water systems are required to be designed by a registered professional engineer. Treatment processes for noncommunity systems installed for reasons other than MCL compliance or disinfection are not required to be designed by a professional engineer if the following conditions are met:

- a. chemicals must meet NSF Standard 60;
- b. equipment components must meet NSF Standard 61; and
- c. all cross-connection hazards are eliminated in accordance with the requirements of ARM 17.38.300 through 17.38.312.

CHAPTER 6 - PUMPING FACILITIES

6.0 GENERAL

Pumping facilities must be designed to maintain the sanitary quality of pumped water. Subsurface pits or pump rooms and inaccessible installations must be avoided. Pumping stations must not be subject to flooding.

6.1 LOCATION

The pumping station must be located to ensure that the proposed site will meet the requirements for sanitary protection of water quality, hydraulics of the system, and protection against interruption of service by fire, flood, or any other hazard.

6.2 PUMPS

The pump or pumps must be capable of providing the maximum daily pumping demand of the system, exclusive of fire flow. With all pumps in service, the pumps must be capable of providing the maximum daily demand plus fire flow demand of the system. Additional capacity may be required if storage for the pump station service area is inadequate per Section 7 of this circular. If only hydropneumatic storage is provided for the pump station service area, the pumping units must be sufficient to equal or exceed the peak instantaneous demand with the largest pump out of service. For hydropneumatic pumping stations serving 50 or less equivalent dwelling units, MDEQ may allow a reduction in total pumping capacity provided the system can maintain the minimum pressures required in Section 8.1.1 with the largest pump out of service.

6.3 APPURTENANCES

6.3.1 Valves

Each pump must have an isolation valve on the intake and discharge side of the pump to permit satisfactory operation, maintenance, and repair of the equipment. If foot valves are necessary, they must have a net valve area of at least 2.5 times the area of the suction pipe and they must be screened. Each pump must have a positive-acting check valve on the discharge side between the pump and the shut-off valve. Surge relief valves, slow acting check valves, or other means to minimize hydraulic transients must be incorporated in the system design.

6.3.2 Piping

In general, piping must:

- a. be designed so that friction losses will be minimized;
- b. not be subject to contamination;
- c. have watertight joints;
- d. be protected against surge or water hammer and provided with suitable restraints where necessary; and

- e. be such that each pump has an individual suction line or that the lines are manifolded so that they will insure similar hydraulic and operating conditions.

6.3.3 Gauges and meters

Each pump:

- a. must have a standard pressure gauge on its discharge line;
- b. should have a compound gauge on its suction line; and
- c. must have a means for measuring the discharge.

CHAPTER 7 - FINISHED WATER STORAGE

7.0 GENERAL

The materials and designs used for finished water storage structures must provide stability and durability as well as protect the quality of the stored water. Steel, concrete, fiberglass-reinforced plastic, and flexible membrane water storage facilities must follow current AWWA Standards. Other materials of construction are acceptable when properly designed to meet the requirements of Chapter 7 of Department Circular DEQ-1, "Standards for Water Works." Porous material, including wood and concrete block, are not suitable for potable water contact applications.

7.1 PRESSURE TANKS

Hydropneumatic (pressure) tanks, when provided as the only storage facility, are acceptable only in very small water systems. Pressure tanks must meet applicable ASME code requirements. Pressure tanks for which the ASME code does not apply (i.e., those with nominal water containing capacity of 120 gallons or less) must meet ASME code requirements or must satisfactorily pass a hydrostatic test of 1.5 times the maximum allowable working pressure of the tank. The maximum allowable working pressure must be marked on each tank.

7.1.1 Location

The tank must be located above normal ground surface and be completely housed.

7.1.2 System design and sizing

The capacity of the wells and pumps in a hydropneumatic system must be equal to the peak instantaneous demand. The active storage volume of the hydropneumatic tanks must be sufficient to limit pump cycling to the manufacturer's and industry's recommendations. Maximum cycling frequency for pumps not using a variable speed drive must be determined for each pump and for any combination of pumps operated by the same pressure switch when consumer demand is equal to one-half of the pump(s) capacity. Maximum cycling frequency for pumps using a variable speed drive programmed to either maintain constant pressure, constant flow, or match the system design curve, must be determined when the customer demand is one-half of the minimum pumping rate. Reduction of required tank volume for systems with alternating pump controls will not be allowed.

7.1.3 Piping

Each tank in a multiple tank system must have bypass piping or valves to permit operation of the system while the tank is being repaired or painted.

7.1.4 Appurtenances

- a. Each tank must have a means of draining, automatic or manual air blow-off, and a means for adding air.
- b. Control equipment consisting of a pressure gage, pressure relieving device, and pressure operated start-stop controls for the pumps must be provided for the hydropneumatic tank system. Installing a shut-off valve between the pump and the pressure operated start-stop controls must be avoided when possible.

- c. The pressure relieving device must prevent the pressure from rising more than 10 percent above the maximum allowable working pressure. The discharge capacity of the pressure relieving device must be adequately sized. Pressure gages must have a range of no less than 1.2 times the pressure at which the pressure relieving device is set to function.

7.2 OTHER STORAGE SYSTEMS

Other storage systems must be designed to meet the requirements of Chapter 7 of Department Circular DEQ-1, "Standards for Water Works."

7.3 CISTERNS

Cisterns must be designed according to Department Circular DEQ-16, "Montana Standards for Cisterns."

CHAPTER 8 - DISTRIBUTION SYSTEMS

8.0 MATERIALS

8.0.1 Standards

All materials including pipes, fittings, valves, and fire hydrants must conform to the latest standards issued by the AWWA and ANSI/NSF, where such standards exist, and be acceptable to MDEQ. In the absence of such standards, materials meeting applicable product standards and acceptable to MDEQ may be selected.

8.1 WATER MAIN DESIGN

8.1.1 Pressure

All water mains, including those not designed to provide fire protection, must be sized after a hydraulic analysis based on flow demands and pressure requirements. The system must be designed to maintain a minimum normal working pressure of 35 psi. Maximum normal working pressure should be approximately 60 to 80 psi. Minimum pressure under all conditions of flow (e.g. fire flows) must be 20 psi. Minimum required pressures must be based on those occurring at ground level at the highest building sites or fire hydrant served by the proposed water mains excluding service line head losses.

8.1.2 Diameter

The mains must be sized to handle design flows.

8.1.3 Hydrants

Water mains not designed to carry fire-flows may not have standard sized fire hydrants connected to them.

8.1.4 Dead ends

Dead ends must be minimized by looping of all mains whenever practical.

8.2 VALVES

Sufficient valves must be provided on water mains so that inconvenience and sanitary hazards will be minimized during repairs.

8.3 INSTALLATION OF MAINS

8.3.1 Standards

Specifications must incorporate the provisions of the AWWA standards and manufacturers recommended installation procedures.

8.3.2 Cover

All water mains must be covered with sufficient earth or other insulation to prevent freezing.

8.3.3 Pressure and leakage testing

The installed pipe must be pressure tested and leakage tested as required by MDEQ.

8.3.4 Disinfection

All new, cleaned, or repaired water mains must be disinfected, flushed, and microbiologically tested in accordance with AWWA Standard C651.

8.4 SEPARATION OF WATER MAINS AND SEWERS

8.4.1 Parallel installation

Water mains must be laid at least 10 feet horizontally from any existing or proposed gravity sanitary or storm sewer, septic tank, or subsoil treatment system. The distance must be measured edge-to-edge.

If the minimum horizontal separation as described above cannot be obtained, the design engineer shall submit a request for a deviation, along with a description of the problem and justifying circumstances. If the deviation is granted, the sewer must be designed and constructed with the following minimum conditions:

- a. Sewers must be constructed of slip-on or mechanical joint pipe complying with public water supply design standards and be pressure tested to a minimum of 150 psi to assume watertightness; and
- b. Sewer services utilizing in-line fittings and extending to the property lines, or beyond, must be installed and tested in the area of the encroachment. Saddles are not acceptable.

8.4.2 Crossings

Water mains crossing gravity sanitary or storm sewers must be laid with a minimum vertical separation distance of 18 inches between the outside of the water main and the outside of the sewer. This must be the case where the water main is either above or below the sewer. The crossing must be arranged so that the sewer joints will be equidistant and as far as possible from the water main joints. Where a water main crosses under a sewer, adequate structural support must be provided for the sewer to maintain line and grade and to prevent damage to the water main.

If the proper vertical separation as described above cannot be obtained, the design engineer must clearly identify the locations of sub-minimum separation on the plans and must comply with the following:

- a. Vertical separation at crossings between water and sewer mains must be at least six inches;
- b. Sewers must be constructed of slip-on or mechanical joint pipe complying with public water supply design standards and be pressure tested to a minimum of 150 psi to assume watertightness;
- c. At crossings, one standard length of new pipe must be centered at approximately a 90-degree angle in respect to the existing pipe;

- d. Sewer services utilizing in-line fittings and extending to the property lines, or beyond, must be installed and tested within 10 feet of the crossing. Saddles are not acceptable;
- e. Either the water or sewer main must be encased in a watertight carrier pipe which extends 10 feet on both sides of the crossing or the mains must be encased in a minimum of six inches of flowable fill for a minimum of 10 feet on each side of the crossing pipes. If the minimum six-inch separation is not viable, the water line must be relocated and vertical separation at crossings between water and sewer mains must be at least 18 inches.

8.4.3 Force mains

There must be at least a 10-foot horizontal separation between water mains and sanitary sewer force mains and there must be an 18-inch vertical separation at crossings.

8.5 CROSS-CONNECTIONS AND INTERCONNECTIONS

No unprotected cross-connections may exist between the distribution system and any pipes, pumps, hydrants, or tanks whereby unsafe water or other contaminating materials may be discharged or drawn into the system. Cross-connections must be eliminated in conformance with ARM Title 17, chapter 38, subchapter 3 for public systems.

8.6 WATER SERVICE CONNECTIONS

8.6.1 Lead Control

Solders and flux containing more than 0.2 percent lead and pipe fittings containing more than 8 percent lead must not be used on service connections.

8.6.2 Booster pumps

Individual home booster pumps may not be considered or required for any individual residential service from the water supply mains unless specifically approved by MDEQ. Where permitted for multi-story public building services, booster pumps must be designed in accordance with Department Circular DEQ-1 Sections 6.4 through 6.4.4.

8.7 WATER MAIN ABANDONMENT

Mains must be abandoned in a manner to prevent cross-connections and must be entirely or partially removed to prevent future connection to the abandoned main.

CHAPTER 9 - WASTE RESIDUALS

Disposal of waste residuals must be provided in accordance with Department Circular DEQ-1, Chapter 9.

GLOSSARY

See Glossary in Department Circular DEQ-1.