



**Environmental
Protection
Agency**

Guidelines for Design of Small Public Ground Water Systems



Division of Drinking and Ground Waters
June 2023

Foreward

This publication has been prepared as a guide for professional engineers and water supply specialists engaged in the design or development of small public water systems (non-community and communities serving less than 500 service connections) using only ground water, which is not required to treat for a primary contaminant with a maximum contaminant level or a contaminant with a health advisory level (HAL). The objective here is to ensure that new or substantially modified public water system facilities, such as those for small villages, factories, mobile home parks, office buildings, restaurants, condominiums, schools, churches, hospitals, campgrounds, resorts, gas stations, nursing homes, golf courses, and the like will be capable of producing an adequate supply of potable water in compliance with applicable regulations.

The following table may be used as a guide for the applicability of design guidance:

Public Water System (PWS) Description (ground water only)	Guidelines for Design of Small Public Water Systems	Recommended Standards for Water Works
All Transient PWS	X	
Nontransient PWS not required to treat for a primary contaminant or a contaminant with a HAL per OAC 3745	X	
Nontransient PWS required to treat for a primary contaminant or a contaminant with a HAL per OAC 3745		X
Community < 500 not required to treat for a primary contaminant or a contaminant with a HAL per OAC 3745	X	
Community < 500 required to treat for a primary contaminant or a contaminant with a HAL per OAC 3745		X
Community > 500 required to treat for a primary contaminant or a contaminant with a HAL per OAC 3745		X

The purpose of this manual is to present the requirements and procedures necessary to develop an approved water supply system where connection to an existing public water system cannot be made at reasonable cost. This publication includes treatment design criteria for iron, manganese, and hardness removal, which are not required as part of OAC 3745.

The design of water systems using surface water or ground water under the direct influence of surface water is beyond the scope of this manual. Refer to the latest edition of “Recommended Standards for Water Works” for design criteria.

The requirements, criteria, and procedures described in this publication represent current practices of the Ohio Environmental Protection Agency (Ohio EPA). They are subject to change whenever in the judgment of the Agency such a change will be more effective in fulfilling its responsibility under the law.

NOTE: For sewage, a similar publication entitled, “Sewage: Collection, Treatment & Disposal Where Public Sewers Are Not Available” may be obtained from Ohio EPA’s Division of Surface Water.

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Table of Abbreviations

ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and Materials
AWWA	American Water Works Association
BMP	Best Management Practices
CWS	Community Water System
NPDES	National Pollutant Discharge Elimination System
NSF	National Sanitation Foundation
NTNC	Nontransient Noncommunity Water System
OAC	Ohio Administrative Code
ODNR	Ohio Department of Natural Resources
ORC	Ohio Revised Code
PE	Professional Engineer
PTI	Permit to Install
PUCO	Public Utilities Commission of Ohio
PVC	Polyvinyl Chloride
PWSID	Public Water System Identification Number
TNC	Transient Noncommunity Water System
WSC	Water System Council

Policy Statement on Infrastructure Security for Small Public Water Systems

Recent events in the United States and abroad have made it clear that increased security for public water systems is imperative. Review of public water system security infrastructure and practices has shown an industry-wide vulnerability to intentional acts of vandalism, sabotage and terrorism. Protection from these types of threats must be integrated into all design considerations. Security measures are needed to help ensure that public water suppliers attain an effective level of security, no matter how small the water system. Design considerations need to address physical infrastructure security and facilitate security related operational practices and management controls. All public water supplies need to identify and address security needs in design and construction for new projects and for retrofits of existing drinking water systems.

Appropriate design measures for small water systems include the following:

- A. Controlling access and installing fences and locks for all drinking water treatment facilities and vulnerable areas (e.g., wellheads, hydrants, manholes, pumphouses, storage tanks).
- B. Installing locks on all entry gates and doors and installing alarms to indicate unauthorized entry. Do not leave keys in equipment or vehicles at any time.
- C. Installing adequate lighting around wells, pumphouses, treatment facilities and parking areas.
- D. Locking monitoring wells, securing vents by moving them inside or providing vandal resistant screens and fencing.
- E. Cyber security should be considered for all remotely controlled equipment, ensuring software is up to date when applicable.

Statement on Alternative Water Treatment Processes

General

This revision to the “Guidelines for Design of Small Public Ground Water Systems,” also referred to as the “Greenbook,” updates Ohio EPA’s increasing familiarity with newer filter media products. It is recognized the list of media is not all-inclusive and is dynamic. Other processes are understood to exist that may be “emerging” or “alternative” treatment processes at this time. Alternative water treatment processes involve technologies or proprietary products not frequently seen in small public water system design. Although not covered in this publication, Ohio EPA recognizes many of these treatment processes have been successfully used in other settings and will evaluate these processes at public water systems on a case-by-case basis.

Ohio EPA is in the process of developing guidance that describes in more detail the testing requirements for alternative water treatment processes. Testing requirements can vary from minor sample collection prior to design (to validate raw water quality applicability), to a demonstration study, up to more thorough testing on a pilot plant basis for a sufficient time to verify satisfactory performance.

Ground water treatment plants with loading rates higher than described in this manual may be acceptable on a case-by-case basis. It will be necessary to demonstrate to Ohio EPA that the desired water quality can be produced under varying raw water conditions and system flow demands.

Ohio EPA considers alternative ground water treatment processes to include, but not be limited to, the following: membrane filtration, reverse osmosis, anion exchange, ozonation, ultraviolet light inactivation, carbon filtration adsorption, activated alumina and iron-based media. Information on pilot plant study requirements is available

on the Ohio EPA Division of Drinking and Ground Waters website. You can also contact Ohio EPA Central Office or your District Office for more information.

Chapter 1 - Definitions

1.0 Public Water System (PWS)

A public water system as defined in Ohio Administrative Code (OAC) 3745-81-01, is a system that provides water for human consumption through pipes or other constructed conveyances, if such systems have at least 15 service connections or regularly serves an average of at least 25 people at least 60 days a year.; or is any water supply system serving an agricultural migrant labor camp as defined in Section 3733.41 of the Ohio Revised Code.

1.1 Types of Public Water Systems

1.1.1 Community Water System (CWS):

A CWS has at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents.

Examples of a CWS may include, but are not limited to, cities, villages, nursing homes and mobile home parks.

1.1.2 Nontransient Noncommunity Water System (NTNC):

A NTNC serves at least 25 of the same persons at least 6 months per year.

Examples of a NTNC may include, but are not limited to, schools, daycare centers, factories and other places of employment.

1.1.3 Transient Noncommunity Water System (TNC):

A TNC serves an average of at least 25 persons per day for at least 60 days per year.

Examples of a TNC may include, but are not limited to, campgrounds, churches, restaurants and rest areas.

1.1.4 Agricultural Migrant Labor Camp:

Any water supply system serving an agriculture migrant labor camp, as defined in Section 3733.41 of the ORC.

1.1.5 Exempt Water System:

To be exempt from Ohio EPA Drinking Water Regulations (ORC Section 6109.02) a system must meet all of the following conditions:

1.1.5.1 Consist only of distribution and storage facilities and does not have any collection and treatment facilities.

1.1.5.2 Obtain all of its water from, but is not owned or operated by, a public water system.

1.1.5.3 Does not sell water to any person as determined by the director.

1.1.5.4 Is not a carrier which conveys passengers in interstate commerce, e.g., airline, railroad, bus line, boat line, etc.

Chapter 2 - Procedure for Establishing a Small Public Ground Water System

2.0 General

Connection to an existing approved public water system should be given primary consideration. A ground water system may be developed if connection to an approved existing system is impractical. Alternatively, a hauled water system may be considered, (see Section 2.4). The owner must be aware that hauled water systems are more susceptible to interruption of supply and may be more susceptible to contamination.

2.1 Plan Submittal Requirements

2.1.1 According to OAC 3745-91-05 (A):

No person shall begin construction or installation of a public water system or make a substantial change in a public water system, or operate a public water system, until plans have been approved by the Director of Ohio EPA.

Upon receipt of a proper application, the Director shall consider the need for compliance with requirements of the Safe Drinking Water Act, and generally accepted standards for the construction and equipping of water systems and shall issue an order approving or disapproving such plans. In granting an approval, the Director may stipulate conditions designed to ensure that the system will be able to meet the requirements of ORC Chapter 6109 and rules adopted under it.

2.1.2 According to OAC Rule 3745-91-01(C):

“Substantial change” means any change that affects isolation, capacity, flows, water quality, source, distribution or treatment.

Substantial change shall include, but not be limited to, the following:

1. For distribution systems: new waterlines; replacement waterlines that change in size, alignment or material; new tanks; modification in storage; new booster stations; changes in pump capacity and auxiliary power. Some waterline replacements are exempt from detail plan approval in accordance with OAC 3745-91-02.
2. For water sources: any new source or alteration in source, including connection to another source or distribution system; any alteration in collection facilities or equipment.
3. For treatment facilities: new treatment processes, including facilities, equipment or chemicals; changes in chemical feed capacity, feeder type, application points or sequence; modifications to or removal of treatment processes, equipment or chemicals.

Substantial change shall not include the following:

1. For distribution systems: waterline cleaning, re-lining, repairs or like-kind replacement; service connections; and tank maintenance.
2. For water sources: like-kind pump replacement.
3. For treatment facilities: like-kind replacement of components, as defined in OAC 3745-91-01. If there are questions regarding if the proposed replacement meets the design criteria previously approved or if proposed treatment meets the definition of like-kind replacement, contact the Ohio EPA district office.

2.2 Connection to an Existing Approved System

- 2.2.1 Contact existing public water system(s) within an economical piping distance.
- 2.2.2 Determine what needs to be done to facilitate the connection to the existing system.
- 2.2.3 If a waterline needs to be extended to your property, plans for any new water line from the water system to the master meter must be approved by Ohio EPA prior to construction, and the new water lines must be owned by the existing water system before they are placed in service. A service connection to a building or residence from the PWS owned waterline does not require a submission of detail plans to Ohio EPA.

2.3 Development of an Approved Ground Water System

Where there is no existing public water system within economical piping distance, give consideration to the development of a ground water system.

- 2.3.1 Contact the appropriate District Office of Ohio EPA's Division of Drinking and Ground Waters to request an evaluation of a proposed well site and to establish the requirements, design criteria and responsibilities involved. (See the map at the end of this publication, which includes Ohio EPA District addresses and telephone numbers.)
- 2.3.2 Submit a completed well site application to the District Office. The application can be found on the Ohio EPA website.
- 2.3.3 Obtain a well site inspection and site approval from the director. The well site approval is valid for two years.
- 2.3.4 Arrange with an Ohio EPA certified laboratory for analysis of the required parameters for new wells after the well has been drilled and developed. A list of certified laboratories can be found on the Ohio EPA website. Allow at least six weeks for analysis of samples. A list of required parameters (Parameters Required for Complete Well Analysis) is included in OAC Rule 3745-9-09.
- 2.3.5 The well must be constructed and grouted in accordance with the construction and grouting standards prescribed in OAC Chapter 3745-9. All wells must be grouted, including those drilled by the cable tool method. Well construction standards can be found in Section 3.5, with requirements specific to PVC casing noted in item 3.5.3-13. Be advised that the Ohio Department of Health Private Water System Program maintains a registry of drilling contractors who operate in the state of Ohio.
- 2.3.6 Perform a pumping test (refer to Section 3.8) and collect the required samples at the conclusion.
- 2.3.7 Submit the pumping test and sample analyses, prior to plan approval, to the District Office for evaluation and information regarding the treatment processes required for your proposed system based on the sample analyses.
- 2.3.8 Have a professional engineer or a water supply specialist knowledgeable in design prepare plans for the system, covering well construction, treatment, storage and distribution.
- 2.3.9 Submit detail plans. Construction of the treatment, storage and distribution system must not begin until the formal approval letter is received from the director.

2.4 Develop an Approved Storage System Using Hauled Water

Hauled water systems are not recommended for community public water systems. Consult the District Office to determine whether or not the hauled water system will be exempt from Ohio EPA regulation (see Section 1.1.5). If the hauled water system is not exempt, plans will be required (see Appendix G). If the hauled water system will be exempt, the required health department and plumbing permits must still be obtained.

2.5 Plan Submittal and Information Required on Plans

Detail plans are required for a proposed water system. These should be prepared by a professional engineer or a water supply specialist knowledgeable in system design in accordance with OAC 3745-91-03. Plans should be submitted at least 60 days prior to the desired approval date. These plans shall contain the following, where applicable:

- 2.5.1 A site map (Appendix A), drawn to scale, showing existing and/or proposed:
 - 2.5.1.1 Property lines, ownership of land, and land use of surrounding properties.
 - 2.5.1.2 Outlines of buildings, including those relevant to the project which are located on adjacent properties.
 - 2.5.1.3 Water system location.
 - 2.5.1.4 Sewerage system location.
 - 2.5.1.5 Well site(s) with isolation radius (radii), and showing any potential sources of contamination and areas owned or having sanitary protection through recorded easements.
 - 2.5.1.6 Nearby streets, driveways, and enough boundary information to locate the project.
 - 2.5.1.7 Any expected future expansion of the project.
 - 2.5.1.8 North arrow to show orientation.
 - 2.5.1.9 Elevations pertinent to the design.
 - 2.5.1.10 Location of water mains, pump stations, raw water intakes, water plant, waste disposal facilities, and other existing or proposed parts of this system.
 - 2.5.1.11 Locations of potential contaminant sources within drinking water source protection area, both the inner management zone and five year time of travel area.
- 2.5.2 Details showing conformance with standards and requirements for:
 - 2.5.2.1 Source (Chapter 3)
 - 2.5.2.2 Treatment (Chapter 4)
 - 2.5.2.3 Storage (Chapter 5)
 - 2.5.2.4 Distribution (Chapter 6)
- 2.5.3 The application for detail plans on the portal replaces the Water Supply Data Sheet. Following submittal of plans, the submitter is emailed an invoice for the plan review fee. Additional information is located on the Ohio EPA website under the Division of Drinking and Ground Waters website, engineering and plan approval page.
- 2.5.4 Specifications, project summary sheets and supporting data (e.g., well log, pumping test, etc.)
- 2.5.5 Other letters as appropriate such as PUCO certificate of convenience and necessity, if applicable or additional documentation required for obtaining Water Supply Revolving Loan Account (WSRLA) funding.
- 2.5.6 A title page showing, at a minimum:
 - 2.5.6.1 The owner's name and address.

- 2.5.6.2 The official name and address of the public water system.
- 2.5.6.3 The title of the project being submitted for review.
- 2.5.6.4 The public water system identification number (PWSID).
- 2.5.6.5 PE stamp (as required by ORC Section 4733.17 and OAC 3745-91-03).
- 2.5.6.6 Signature of water system owner approving the plans or a signed submittal letter from the owner or the owner's representative, requesting approval of the plans.
- 2.5.7 An asset management program (AMP) is required for new community and non-transient non-community public water systems. The AMP must include the applicable requirements as defined in OAC Chapter 3745-87. An AMP is also required for any existing system receiving State Revolving Loan Funding or Drinking Water Emergency Loan Funding.

Chapter 3 - Source

3.0 General

This section overviews requirements for developing a groundwater supply source. The engineer or water system specialist responsible for designing the groundwater system must demonstrate an adequate quantity of safe drinking water will be available to consumers. Approval of a groundwater source will be contingent on the quality and quantity of water supplied from the proposed well(s).

Metering of the water shall be provided for all community water systems and recommended for all noncommunity water systems.

3.1 Availability of Well Water

The availability of an adequate well water supply is a major consideration in the selection of a well site. Information on the availability of ground water can be obtained from the Ohio Department of Natural Resources, Division of Soil and Water Resources, Ground Water Mapping and Technical Services Section (Tel: 614-265-6747).

3.2 Quality of Water

3.2.1 Microbiological Quality

Before any new, reconditioned or modified well is placed into potable service, the well must be disinfected in accordance with Section 3.10. Total chlorine shall be tested and the results of the test noted on the sample submission form. Total chlorine shall be undetectable prior to sampling for microbiological samples. Two consecutive total coliform negative microbiological samples taken at least 30 minutes apart shall be taken from the well. Analysis shall be performed by an Ohio EPA certified laboratory. Ohio EPA certified laboratory list can be found on the Ohio EPA Division of Environmental Services webpage. Additional monitoring may be required if the grouting of the well is questionable.

If a well cannot achieve negative (safe) bacteriological samples, it may require treatment which is beyond the scope of this manual. Contact your District Office for further guidance.

3.2.2 Chemical and Radiological Quality

Every proposed ground water source must be examined for applicable chemical and radiological characteristics by analysis of a representative sample in a laboratory certified by Ohio EPA. Note if contaminants are detected, then re-sampling may be required to confirm the results.

The samples for laboratory analysis must be collected at the conclusion of the pumping test procedures and prior to initiation of the recovery period. Ohio EPA can advise on whether the well can be approved, and on methods and types of treatment required on the basis of the results of required analyses (see OAC 3745-9-09 (C)). Wells, with sample results exceeding maximum contaminant levels (MCL), may require treatment beyond the scope of this manual. Contact District Office for further guidance.

3.2.3 Secondary Standards

The presence of contaminants above the secondary maximum contaminant level (SMCL) may require treatment.

Treatment may be required for community and non-transient non-community water systems to remove excessive levels of iron and manganese, which cause staining of laundry and plumbing fixtures and which give the water a mineral taste (see Chapter 4). Abnormally high amounts of chlorides, sulfates and total dissolved solids can also make water objectionable for drinking. High levels of sodium are a concern when serving communities with sodium restricted diets. Community PWSs having sources with elevated levels, above 20 mg/L, of sodium are strongly encouraged to ensure the susceptible population is informed and educated.

3.3 Well Site Approval

3.3.1 Requirements

Sites for public water supply wells must be approved by Ohio EPA before the wells are drilled or when an existing system is designated a public water system. Contact the District Office for more information.

3.3.2 Submittals

Submit a completed well site application, available on the Ohio EPA website, to the District Office.

NOTE: Refer to Appendix B for suggested water usage guide. Alternative methods of obtaining water usage such as fixture counts or historical flow and pressure data may be used in certain circumstances as described in Section 3.4.

3.3.3 Site Visit

The District Office will review the well site application and contact you to arrange for a site visit. A representative of the system, and the selected well driller, should be present during this visit. Several items may be discussed in the field including, but not limited to:

1. Sanitary control of isolation zone surrounding the proposed well. (See Section 3.3.5).
2. Known or suspected water quality issues.
3. Detail plan preparations.
4. Source water protection.
5. Certified laboratories for analysis.

The District Office will be available to answer questions the system representative may have regarding the well site.

3.3.4 Site Evaluation

The owner will receive a letter from the director either approving or denying the site for the proposed project. Additional requirements may be stipulated in the well site approval letter.

3.3.5 Isolation Standards and Well Siting Criteria

A proposed public water system well shall be located the maximum practical distance from potential or known contamination. Unless local conditions dictate greater distances, approval of each well site will be based on compliance with the following isolation radii and well siting criteria:

Estimated Average Daily Water Usage (Q)	Minimum Isolation Radius from Sources of Possible Contamination
0-2,500 gpd	50 feet
2,501-10,000 gpd	(Square Root of Q) feet
10,001-50,000 gpd	(50 + Q/200) feet
Over 50,000 gpd	300 feet

Well isolation radius will be determined in the Director’s well site approval letter and finalized in the Director’s plan approval letter. The isolation radius can only be adjusted with an updated Director’s plan approval letter.

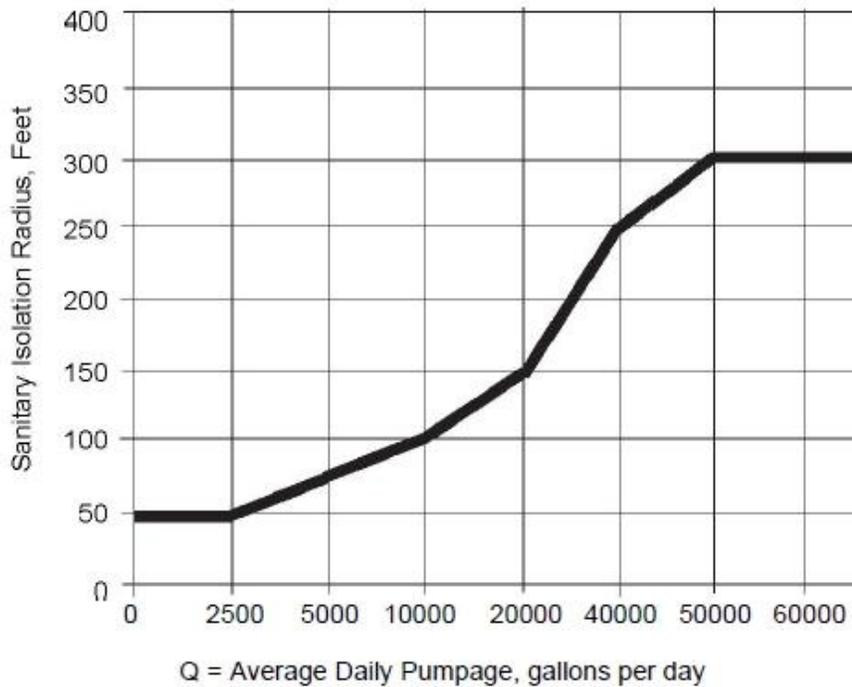


Figure 1 - Well Isolation Radius

Use Figure 1 to calculate the required isolation radius. Normally, the required isolation distance shall be rounded up to the nearest five feet.

Potential sources of contamination shall not be constructed or placed within the sanitary isolation radius of a public water system well.

Where geological factors warrant less isolation from sources of contamination, a qualified ground water professional's report to that effect, together with a statement of protective measures, may be accepted.

Where fractured bedrock or extremely porous subsoil extends to or near the surface of the ground or where poor drainage or other unfavorable conditions are encountered, greater isolation distance or treatment as a surface water supply may be required.

The owner of the well shall own all of the land or obtain a sanitary easement or lease of the sanitary isolation radius of the well. Land application of sludge or manure shall not be applied within easements. The easement or lease must meet specifications set forth in OAC Rule 3745-9-04 and shall be recorded with the County Recorder's Office. Any proposed change in land use within the isolation radius requires consultation with Ohio EPA. Additionally, if proposing to use fertilizers, herbicides, or pesticides within an easement, please consult Ohio EPA to ensure the methods used to apply and select chemicals adequately prevent contaminants from infiltrating the well; Ohio EPA may require additional monitoring based upon circumstances.

The well shall be adequately protected from physical damage. The installation of barriers may be required to protect the well from vehicular traffic or other inadvertent damage.

A public water system well shall be located at least:

1. Ten feet from the foundation of any building, except within a pumphouse.
2. Fifty feet from streams and lakes.
3. Three hundred feet from a human or animal waste management facility.
4. Three hundred feet from a land application area, stockpile, storage or staging area.
5. One hundred feet from a land application area field if the waste is injected or three hundred feet if the waste is surface applied but in no case within the sanitary isolation radius of the well.
6. Three hundred feet from a soil absorption system handling more than ten thousand gallons per day.
7. One thousand feet from a landfill or monofill.
8. Five hundred feet from a construction and demolition debris facility.
9. Outside of a floodway unless prior approval is obtained from the director. Casing must terminate at least 3 feet above the 100 year flood plain level. Wells located within wetlands may require additional permits. Contact the Division of Surface Water for more information.

A public water system well used by a community or nontransient noncommunity public water system shall be located such that the following are not located within the proposed well's inner management zone as determined by the system's Source Water Assessment and Protection Plan (SWAP):

1. Human or animal waste management facility, except a well that is used by the facility.
2. Soil absorption system handling more than ten thousand gallons per day in an area where the Ohio EPA has determined the aquifer has a high susceptibility to contamination.
3. Land application stockpile, storage or staging area where the Ohio EPA has determined the aquifer has a high susceptibility to contamination.

A public water system well shall be sited such that no landfill or monofill is located within the proposed well's drinking water source protection area (5 year time-of-travel).

Other possible sources of contamination must be brought to the attention of the District Representative and their potential effect on the proposed well evaluated by the District Representative. Possible sources of contamination include, but not limited to:

1. Grossly contaminated (chemical or bacteriological) rivers, streams or drainage ditches. Rivers, streams and ditches are not considered as possible sources of contamination.
2. Sewers that carry sanitary or chemical waste, or storm water or field drainage tiles.
3. Septic tanks, leaching wells or beds, privies, cesspools, surface or subsurface sand filters, sewage force mains, or sewage treatment plants.
4. Livestock holding areas, barnyards or feed lots for which feed is brought in from another source. Pasture land is not considered as a possible source of contamination.
5. Railroad right-of-ways in which spills may have occurred or defoliant agents may have been applied.
6. Waste or product storage tanks (above or below ground), oil and gas production wells, mining operations, landfills, disposal areas old or new, demolition fill areas, pipelines (gas mains, oil mains, etc.), manufacturing facilities in the proximity of the proposed well field, and abandoned wells which are not properly sealed.

3.3.6 Sanitary Sewers in Well Field Areas

The current Ohio EPA policy regarding sanitary sewers in a well field area is as follows:

- 3.3.6.1 Sanitary and combined sewers are not acceptable in well field areas; however, they may be permitted under exceptional and unavoidable circumstances. Pressure sewers and manholes shall not be permitted under any circumstances. In any case, sanitary and combined sewers and associated manholes shall not be located closer than 50 feet or one-third of the isolation radius, whichever is greater, approved for that well or specified by the Division of Drinking and Ground Waters guidelines. Gravity sewer laterals should meet the 50 feet isolation radius.
- 3.3.6.2 The Division of Drinking and Ground Waters may require quarterly or monthly bacterial and nitrate/nitrite monitoring of each well when sanitary sewers are located within the isolation radius.

- 3.3.6.3 A best management practices (BMP) program shall be implemented for sanitary sewers or combined sewers within well field areas. Provisions shall be made for periodically pressure testing the sewer. The sewers shall be pressure tested at a frequency determined by the District Office, at a minimum of every five years.
- 3.3.6.4 Where sewers are being installed, the sewer materials shall be appropriate pressure rated pipe and shall be pressure tested to ensure water tightness.

3.4 Basis of Design

3.4.1 Requirements

The primary well system must be capable of providing an adequate supply of water during normal and peak usage periods. In addition, standby or alternate sources may be required in case of emergency, pump failure, etc., as described in Section 3.4.3.

Calculate the average daily, peak daily, and peak hourly demands using factors not less than those shown below:

1. **Average Daily Demand** = The estimated average daily water demand shall be determined by using either the table provided in Appendix B or at least one year of historical water use. Average Daily Demand may be determined by less than a year of historical data, incorporating a safety factor. Contact your District Office Engineering Section with regard to determining the safety factor for your system.
2. **Peak Daily Demand** = Average Daily Demand x 2.0, unless a lower peak demand factor is supported by at least three years of historical daily flow data using the highest peak day to average day ratio for the period of record.
3. **Peak Hourly Demand** = Average Daily Demand x 10*

(* Other sizing or design methods, such as fixture counts, conforming to documented engineering practice standards are also acceptable alternatives. A lower peak hourly demand factor must be supported by at least one year of continuous flow and pressure data).

Note: The capacity of the design pump cannot exceed the pumping test rate. See Section 3.8 for pumping test information.

3.4.2 Procedure

- 3.4.2.1 **Drill Well:** After the well site approval letter has been received (Section 3.3), the proposed well may be drilled. Only water system contractors holding a valid registration from the Ohio Department of Health may drill a well or install a pitless adapter or pitless unit for a public water system well.
- 3.4.2.2 **Test Pump:** The well shall be pump tested to determine its capacity and to obtain water quality samples as required. Air pumping or bailing is generally not acceptable for this test. Static and pumping water levels and recovery rates shall be measured and recorded. See Section 3.8 for pumping test report requirements.
- 3.4.2.3 **Alternative:** If the well does not have sufficient capacity to meet the standards of 3.4.3, outlined below, the owner shall contact the District Office for assistance.

3.4.3 Standards

- 3.4.3.1 All new community water systems and noncommunity water systems with a consumption exceeding 50,000 gpd or with a population of 500 or greater shall be capable of meeting peak demand with the largest well out of service. Existing community water systems with only one fully functional well will be required to have two or more wells sized in accordance with Section 3.4.3.2 when the existing well fails or cannot substantially meet peak demand, or when the system demand causes pressure in the distribution system to fall below 35 psi. An acceptable alternative to a redundant well would be an emergency connection to another public water system with adequate capacity to meet peak demand.
- 3.4.3.2 Well Field and Treatment Capacity: The capacity of the wells, well pumps and treatment components in a hydropneumatic pressure system must be sufficient to produce water at a rate that is ten times the average daily water demand (See Figure 2, point “A”) or approved alternative peak hourly flow rates. Where the aquifer cannot support this withdrawal rate, a storage tank with high service pumps may be used to meet this peak requirement, provided that the wells, well pumps and treatment components are able to produce water at a rate that is twice the average daily water demand. (See Figure 2, point “B”. At point “B”, one day’s storage is required.) Please note that, at a minimum, the total well field capacity must meet the peak daily demand (twice the average daily water demand).

In addition, the wells, well pumps and treatment components in a hydropneumatic pressure system using over 50,000 gpd must be sufficient to produce water at a rate that is five times the average daily water demand with the largest well or treatment unit out of service (See Figure 2, point “C”). Where the reduced well field cannot support this withdrawal rate, a storage tank with high service pumps may be used to meet this peak requirement, provided that the reduced well field is able to produce water at rate that is at least equal to the average daily water demand. (See Figure 2, point “D”. At point “D”, one day’s storage is required.) Please note that, at a minimum, the reduced well field capacity must meet the average daily water demand. If withdrawal is anticipated to be greater than 100,000 gallons per day, then PWS should contact Ohio Department of Natural Resources on permitting requirements.

Figure 2 can be used to determine storage requirements. A sample problem is provided following the graph (Figure 3). The example is solved by utilizing the graph and storage equations. Alternative methods for estimating storage requirements may be submitted for consideration.

Water usage values are provided in Appendix B as an aid to calculate average daily water demand.

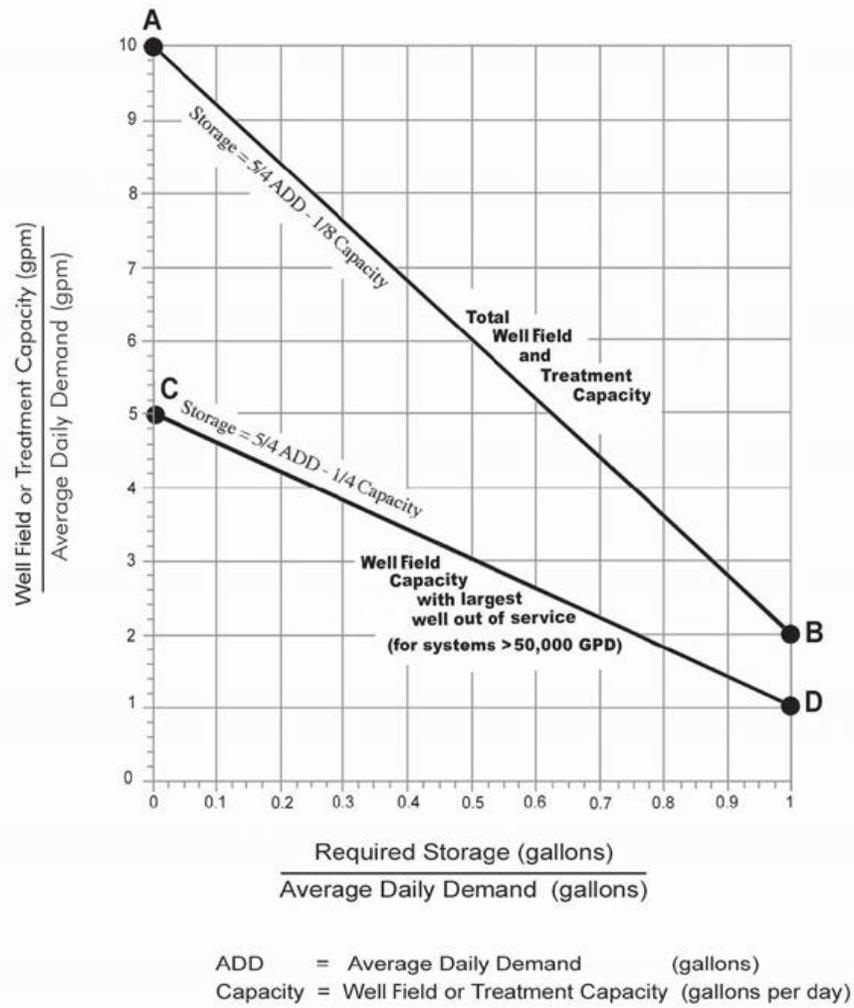
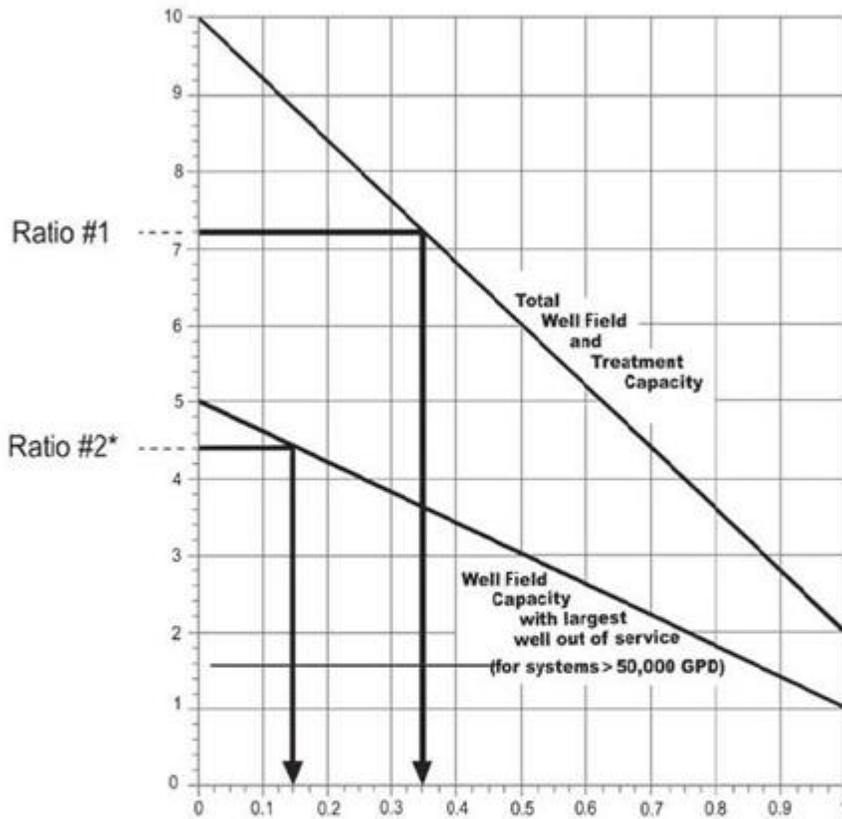


Figure 2 - Determining Storage Requirements

Calculate Ratio #1: $\frac{\text{Total Well Field Capacity (gpm)}}{\text{Average Daily Demand (gpm)}}$

Calculate Ratio #2*: $\frac{\text{Well Field Capacity with largest well out of service (gpm)}}{\text{Average Daily Demand (gpm)}}$



From the Graph: $\frac{\text{Required Storage (gallons)}}{\text{Average Daily Demand (gallons)}} = 0.35$

Therefore: Required Storage = 0.35 x Average Daily Demand

* Ratio #2 is only calculated for systems using more than 50,000 gpd and then the larger of the two numbers along the bottom of the graph would be used

In lieu of using the graph, the equations for each line can be used to calculate the storage requirement. Equation #1 is always used, however, Equation #2 must also be considered if the public water system uses more than 50,000 GPD and then the storage requirement would be the greater of the two calculations.

Equation #1 Storage = 5/4 ADD - 1/8 Capacity (Total Wellfield and Treatment Capacity)
Equation #2 Storage = 5/4 ADD - 1/4 Capacity (Wellfield Capacity with largest well out of service)

ADD = Average Daily Demand (gallons)
 Capacity = Wellfield or Treatment Capacity (gallons per day)

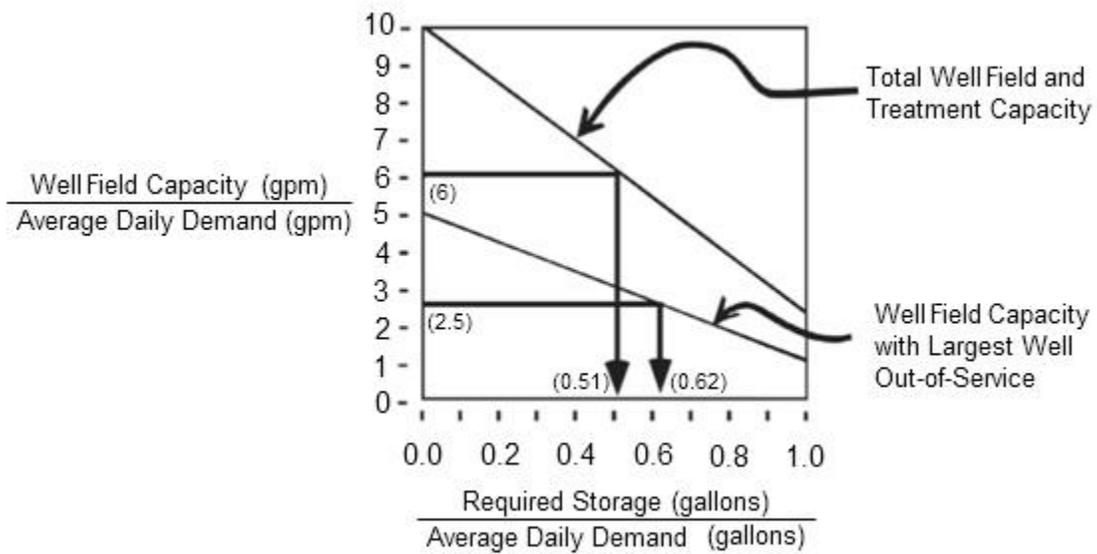
Figure 3 - How to Calculate Storage Requirements

NURSING HOME

Well #1 =	175 gpm	455 patients @ 150 gpd*	=	68,250 gpd
Well #2 =	50 gpm	15 resident employees @ 100 gpd	=	1,500 gpd
Well #3 =	50 gpm	45 non-resident employees @ 50 gpd*	=	2,250 gpd
Well #4 =	25 gpm			72,000 gpd (50 gpm)
Total =	300 gpm			

Ratio #1 = $\frac{\text{Total Well field Capacity}}{\text{Average Daily Demand}} = \frac{300 \text{ gpm}}{50 \text{ gpm}} = 6$

Ratio #2 = $\frac{\text{Well field Capacity with Largest Well Out-of-Service}}{\text{Average Daily Demand}} = \frac{125 \text{ gpm}}{50 \text{ gpm}} = 2.5$



From the Graph: $\frac{\text{Required Storage (gallons)}}{\text{Average Daily Demand (gallons)}} = 0.62$

Therefore:

Required Storage = 0.62 x Average Daily Demand = 0.62 x 72,000 gallons = 44,640 gallons

*values obtained from water usage table in B

Example (solve by using the equations)

NURSING HOME

Well #1	=	175 gpm	=	252,000 gpd	455 patients @ 150 gpd*	=	68,250 gpd
Well #2	=	50 gpm	=	72,000 gpd	15 resident employees @ 100 gpd*	=	1,500 gpd
Well #3	=	50 gpm	=	72,000 gpd	45 non-resident employees @ 50 gpd*	=	2,250 gpd
Well #4	=	25 gpm	=	36,000 gpd			
					Total		72,000 gpd
<u>Total</u>	=	<u>300 gpm</u>	=	<u>432,000 gpd</u>			
Total	=	125 gpm	=	180,000 gpd	(without largest well)		

Total Well field and Treatment Capacity

(Equation #1)

$$\begin{aligned} \text{Storage Requirement} &= 5/4 \times \text{ADD} - 1/8 \times \text{capacity} \\ &= (5/4)(72,000) - (1/8)(432,000) \\ &= 90,000 - 54,000 \\ &= 36,000 \text{ gallons} \end{aligned}$$

Well field Capacity with Largest Well Out-of-Service

(Equation #2)

$$\begin{aligned} \text{Storage Requirement} &= 5/4 \times \text{ADD} - 1/4 \times \text{capacity} \\ &= (5/4)(72,000) - (1/4)(180,000) \\ &= 90,000 - 45,000 \\ &= 45,000 \text{ gallons} \end{aligned}$$

Conclusion: Storage Requirement = 45,000 gallons

*values obtained from water usage table in B

3.5 New Well Construction

3.5.1 Requirements

Well construction shall be such as to prevent contamination of the water and of the water-bearing formation by either surface or subsurface sources (OAC Rule 3745-9-05).

3.5.2 Procedure

Wells shall be drilled, constructed, grouted and developed in accordance with Ohio EPA's Water Well Standards (OAC Rule 3745-9).

3.5.3 Standards

The most recent edition of Ohio EPA's Water Well Standards (OAC Chapter 3745-9) applies to all well construction and should be consulted for specific information. General criteria, applicable to all wells, are as follows:

1. Minimum casing diameter is 5 inches.
2. Well casing height above finished grade shall be at least 12 inches and at least 12 inches above the well house floor or concrete apron surface.
3. Solid, watertight casing shall extend at least 25 feet below ground surface.
4. Minimum grout depth shall be 25 feet below ground surface (OAC Rules 3745-9-06 & 07).
5. A well cap shall be provided. Electrical conduit connections on the well cap shall be threaded or sealed to prevent the entrance of insects and water. Well cap shall conform to 'Water System Council Pitless Adaptor Standard PAS-97' or with an alternative standard acceptable to the director. In circumstances where an alternative well cap is required based upon the well construction or geologic setting, the alternative well cap must be approved by the director prior to installation.
6. The well shall be provided with a downturned screened vent. Well vents that are integral with the well cap are acceptable so long as they are screened and face downward. When vertical turbine pumps are used, access for water level measurements must be provided.
7. Pitless adaptors or pitless units shall be lead free and conform to "Water Systems Council Pitless Adaptor Standard PAS-97" or with an alternative standard acceptable to the director.
8. Well screen shall be installed where the geological formations are unconsolidated or incompetent.
9. A check valve or foot valve should be provided within the drop pipe.
10. A submersible well pump shall neither have a mercury seal, nor shall any other components of the well construction contain mercury.
11. Each well shall be provided with a smooth nose (no threads on spigot) sample tap for collecting raw water samples. The sample tap can be located in a valve pit or other location which is accessible and protected from freezing. Commercial sampling hydrants may be considered. The sample tap shall be located prior to any pressure tanks or treatment units and shall allow for collection of a representative ground water sample from each well.
12. Each well is to be provided with a means to isolate it, sample it and pump it to waste while keeping all remaining wells in service. Yard hydrants at the wellhead may be suitable for sampling and pumping to waste. Sanitary yard hydrants, if used, must conform to OAC Rule 3745-95-09.
13. Well casing shall conform to the following:

Steel [See OAC Rule 3745-9-05]

Minimum thickness

Pipe specification

Joint specifications

PVC [See OAC 3745-9-05]

Minimum SDR

Pipe specification

Joint specifications

The use of PVC casing is generally not approved for wells near underground fuel storage, known soil contamination or other sources of chemicals that can degrade and permeate PVC.

14. The water service pipe installed below ground, between the well and the treatment plant, shall be maintained under system pressure at all times. A check valve or backflow prevention assembly shall not be installed between the pitless device and the pressure tank.
15. The water service pipe installed below ground, between the well and the treatment plant or distribution system, shall be sufficiently buried to prevent it from freezing (typically 4 feet).
16. The water service pipe installed below ground, between the well and the treatment plant or distribution system, shall be certified for potable water use by either the National Sanitation Foundation (NSF) or American Water Works Association (AWWA).
17. The "Well Profile and Construction Form" (Figure 4) is an illustration of well terminal development and includes most specifications needed for plan approval. This form should only be used for single cased wells with submersible pumps and pitless adaptors. Other well configurations (gravel packing, vertical turbine pumps, etc.) shall have a plan submitted showing the actual construction of the well.

3.6 Casing Extensions

If an extension to an existing well casing is needed to meet the required height above finished grade, a below grade bolted steel coupling may be used. Such couplings may be used to join similar or dissimilar materials or sizes. Bolted steel couplings used for this purpose must conform to the following criteria:

1. Conform to ANSI/AWWA Standard C219 Bolted, Sleeve-Type Couplings for Plain-End Pipe", catalog number 43219.
2. Have a collar with the same or better strength and rigidity of the well casings being joined together.
3. Be composed of a cast steel unit joined by a minimum of four stainless steel bolts spaced uniformly around the circumference of the coupling.
4. Provide for the well casing to extend at least 2.5 inches into the throat of the coupling. Ensure that the coupling is centered over the joint.

5. A connection to a well casing that is made above ground shall be installed through the following methods:
 - a. Threaded connection.
 - b. Welded connection.
 - c. Bolted flanges with rubber gaskets at twelve inches or greater above ground surface.
 - d. Extension of the casing at least 0.5 inch into the base of a pump mounted on and sealed to a concrete pedestal.

PWS Name: _____
 PWS ID: _____
 Well ID: _____

Aquifer Type: _____
 Latitude: _____
 Longitude: _____

Vented Well Cap
 Make: _____ Model: _____
 PAS-97: Yes: _____ No: _____

Casing
 Material: _____ Diameter: _____
 Ground Elevation: _____
 100-Year Flood Elevation: _____

Grouting
 Material: _____ Depth: _____
 Annular Space: _____ Vol/Wt Used: _____
 Method of Placement: _____

Pitless Installation Device
 Make: _____ Model: _____
 Length: _____
 Approval Type: NSF: _____ AWWA: _____

Discharge Line
 Make: _____ Model: _____
 Length: _____
 Approval Type: NSF _____ AWWA _____

Pumping Test (attach actual pumping test form)
 Duration of Test: _____ Static Level: _____ ft
 Pumping Rate: _____ gpm
 Maximum Drawdown: _____ ft

Pump (attach pump curve)
 Make: _____ Model: _____
 Capacity: _____ gpm at _____ TDH
 Horsepower: _____

Pump Motor
 Phase: _____ Voltage: _____
 Cycle: _____ Hz RPM: _____

Well Screen
 Type: _____ Material: _____
 Slot Size: _____ Diameter: _____
 Depth: _____ and to _____

Well Driller
 Company Name: _____
 Address: _____
 Phone #: _____

I verify all well components installed are appropriately certified by ANSI, NSF 60/61, and/or UL.

Signed: _____
 Date: _____

Disinfection
 Describe well disinfection procedure used:

Additional Equipment
 Describe below any additional items that will be installed with the well (i.e. gravel refill tubes, vent extension)

Note: When completing this form, be sure to fill out the dimensions provided in the illustration.

Figure 4 - Well Profile and Construction Form

3.7 Approval of Existing Wells as Public Water Supply Wells

3.7.1 Requirements

Existing private wells, unapproved wells or non-potable wells, to be converted into public water supply wells shall meet the same requirements and standards as a new well. In addition, assurance is required that the well has been properly constructed and that the well is in satisfactory condition.

3.7.2 Detail Plan Approval Exemptions

Water systems newly discovered or re-opened after temporarily closing and meeting the definition of a public water system in OAC Rule 3745-81-01, are exempted from obtaining plan approval for wells if all of the following conditions are met:

1. A complete well analysis (including total coliforms count and possibly nitrate) is submitted and demonstrates acceptable water quality, or a variance is granted in accordance with OAC Rule 3745-9-02, except in the following two circumstances:
 - 1.1. Community or nontransient noncommunity public water systems that have been closed for less than three years;
 - 1.2. Transient noncommunity public water systems that have been closed for less than five years.
2. A well meeting minimum casing depth or casing height standards, contained in OAC Chapter 3745-9 as documented by the Director,.
3. All well siting requirements are met in accordance with OAC Rule 3745-9-04..

3.7.3 Procedure

Follow the same procedure as for new well approval. In addition, a water system contractor holding a valid registration from the Ohio Department of Health shall inspect the well for acceptability regarding:

1. Casing condition.
2. Total cased depth.
3. Total well depth.
4. Length and depth of the well screen(s).
5. Upper terminal development including the pitless installation device, grouting, venting, water tight well cap and freeze protection for the discharge line. In addition, a well log and/or a well construction work sheet (see Appendix C and Appendix D) must be completed and submitted.

3.7.4 Standards

1. Corrosion: The casing shall be free of excessive corrosion.
2. Casing Depth: The cased depth shall be at least 25 feet unless otherwise approved.
3. Pitless Installation Device: The pitless installation device shall conform to National Sanitation Foundation or Water System Council Standards and be free of defects which could lead to leakage.
4. Freeze Protection: The pitless installation device and discharge line shall be installed at sufficient depth (normally about 4 feet) below ground surface to avoid freezing.

3.8 Pumping Tests

A pumping test is required to determine the amount of water that can be safely withdrawn from the well for an indefinite period of time. The pumping test shall be used to determine the specific capacity of the well at the anticipated permanent design pumping rate for all high use wells intended to serve as a source to a community public water system. There are three variations of the pumping test based upon whether the well is classified as low, medium or high use as explained in the table below.

Classification	Estimated Average Daily Demand of the Well (gallons per day)
Low use	0 - 10,000
Medium use	10,001 - 100,000
High use	greater than 100,000

3.8.1 Pumping Test Rates

Acceptable pumping tests for low, medium or high use classification are as follows:

1. For low or medium use wells, the pumping test shall be conducted at a constant rate for a period of at least normal operation either at the peak hourly demand, or at least 1.5 times the anticipated permanent design pumping rate whichever is greater. If the well cannot sustain peak hourly demand, the pumping test shall be conducted at a minimum of 1.5 times the anticipated design pumping rate. For a community water system well, the duration of the constant rate pumping test shall be no less than twenty-four hours.
2. For all high use wells, a step-drawdown test shall be conducted, followed by a constant rate pumping test.
 - a. The step-drawdown test shall be used to obtain sufficient hydrogeologic information to design an appropriate constant rate pumping test for the well. The step draw-down test shall, at a minimum conform to the following:
 - i. Consist of three or more steps of progressively increasing pumping rates.
 - ii. One step shall be performed at the anticipated permanent design pumping rate.
 - iii. Each step shall be of approximately equal duration.
 - iv. Each step shall be performed at a constant pumping rate for no less than forty-five minutes.
 - b. The constant rate pumping test shall be conducted for at least twenty-four hours at a pumping rate of at least 1.5 times the anticipated permanent design pumping rate. The constant rate pumping test shall not commence until the water level has recovered to at least ninety percent of the drawdown caused by the step-drawdown test or twenty-four hours after the completion of the step-drawdown test, whichever comes first. For high use wells, all pumping tests shall include water level measurements from observation or surrounding wells.

3.8.2 Reduced Rate Pumping Test

For low, medium or high use wells, the constant rate pumping test may be conducted at a lower pumping rate if it is believed pumping the well at 1.5 times the anticipated permanent pump design rate will be excessive, will not be possible, or will have adverse effects on the long-term performance of the well or aquifer. The test may be conducted at a lower pumping rate if the following criteria are met:

1. The constant rate pumping test is conducted at no less than 1.2 times the pump design rate.

2. A demonstration is provided that supports the reasoning for a lower pumping rate that even under adverse conditions, including but not limited to severe drought, the well will likely be able to supply water at the anticipated permanent design pumping rate over the anticipated functional life of the well.

Regardless of well classification, the capacity of the design pump may not exceed the pumping test rate. The capacity of the permanent pump must be equal to or less than the constant pumping test rate.

NOTE: It is recommended that a person with demonstrated competency perform the respective pumping test or aquifer test.

3.8.3 Sampling

Samples shall be collected and analyzed from a public water system well for contaminants at the conclusion of the constant rate pumping test, and prior to initiation of the recovery period. The list of contaminants may contain inorganics, radiologicals, synthetic organic chemicals (SOCs), volatile organic compounds (VOCs), Per- and polyfluoroalkyl Substances (PFAS), and bacteria. The contaminants required for each type of public water system are listed in the Appendices of OAC Rule 3745-9-09.

3.9 Reporting

The following records are to be included with detailed plan submission:

3.9.1 Well Logs

A well log is to be recorded with the Ohio Department of Natural Resources (ODNR) by the driller at the time the well is drilled. A copy of a properly filed ODNR well log must be submitted to Ohio EPA as part of the detail plans for a new well.

Copies of existing well logs may be obtained from the Water Wells Database provided by ODNR. Contact ODNR, Division of Geological Survey, by e-mail at geo.survey@dnr.ohio.gov or by phone at (614) 265-6576 with questions concerning the water well database.

3.9.2 Pumping Test Report

A report shall be submitted which includes the pumping tests with their results, interpretations, and conclusions. For all wells, the pumping test report shall include items in 1-8 at minimum:

1. Date and times of starting through ending pumping test.
2. Pumping rate and depth at which the pump used for the test was set.
3. A data table for each well used to observe the drawdown and recovery water level measurements, showing the time after the pump test started and the corresponding water level measurements to the nearest 0.1 foot.

Water level measurements shall be at these time intervals:

Time after Pumping Test Started (minute)	Time Interval Between Measurements (minute)
0-15	1
16-60	5
61-120	10
121-180	20
181-300	30
Greater than 300	60

4. Specific capacity of the well at the tested pumping rates.
5. For high use wells only, the specific capacity of the well at the anticipated permanent design pumping rate after drawdown has stabilized.
6. Anticipated permanent pump setting depth (in feet below ground).
7. Height above ground (in feet) of the water level measurement reference point.
8. Water level measurements must be taken immediately after termination of the constant rate pumping test at time intervals of five minutes for the first hour and every thirty minutes thereafter until the water level has recovered to at least ninety percent of the drawdown caused by the pumping test.
 1. In addition to the requirements 1 through 8 listed above, a high use water system well pumping test report shall also include:
 - a) A map showing the location of the pumping wells and the location of other wells used to observe drawdown. The map shall, at a minimum, include the names of the wells as used in the report and the distance between the pumping well and other wells used to observe drawdown.

- b) Graphs plotted on semi-logarithmic graph paper showing the drawdown measurements on the arithmetic scale and time on the logarithmic scale. Graphs must be submitted for the pumping well and any other wells used to observe drawdown and recovery during the pumping test.
 - c) Graphs plotted on semi-logarithmic graph paper showing the recovery measurements on the arithmetic scale and time on the logarithmic scale. Graphs must be submitted for the pumping well and any other wells used to observe drawdown and recovery during the pumping test.
 - d) Arithmetic graphs showing all water-level data collected during the pumping test and recovery period from the pumping well and all observation wells.
9. If the high use well is part of a multiple-well system the report shall also include documentation demonstrating:
 1. The well can supply water at the anticipated permanent design pumping rate while at minimum maintaining the operational capacity of the well field and without degrading the water quality of any well in the well field.
 2. Analyses of the effects of interference drawdown from other wells owned by the PWS, as well as other high capacity wells not owned by the PWS. Operational practices and the potential to cause degradation of water quality at the well field should also be considered when establishing a permanent design pumping rate for a new PWS well.

3.10 Disinfection of Wells

3.10.1 Requirements

All wells shall be properly disinfected by chlorination before being placed into service. OAC Rule 3745-9-08 specifies well disinfection procedures and should be consulted; however, a summary is provided below.

3.10.2 Procedure

1. Disinfectant shall be slowly poured into the well by wetting the inside casing circumference, drop pipe and electrical cable.
2. Disinfectant concentration in the water column shall be initially at least one hundred milligrams per liter chlorine. AWWA specification, C654-13, can be consulted to determine the necessary amount of sodium or calcium hypochlorite needed. If using unscented bleach, the following formula can be used:

$$(R)^2(D)(0.000272) = \text{gallons of bleach containing 6\% sodium hypochlorite}$$

R = radius of the well in inches

D = depth of water in the well in feet

EXAMPLE

6 inch diameter well

40 feet of water in the well

$$(3)^2(40)(0.000272) = 0.097 \text{ gallons (approximately 0.1 gallons, or 1.5 cups)}$$

Therefore: 0.1 gallons (1.5 cups) of bleach containing 6% sodium hypochlorite will establish a chlorine residual of 100 mg/L in a 6-inch well that has 40 feet of water.

3. Water in the well shall be agitated or surged to ensure even dispersal of the disinfectant throughout the entire water column. Recirculating water back into the well casing from an outside spigot may distribute chlorine throughout the water column if the well pump is located at the bottom of the well.
4. Cap the well and allow it to stand at least eight hours.
5. After disinfection, a well shall not supply water for human consumption until it has been found to be microbiologically safe. Total coliform samples shall be collected at least eight hours after disinfection and after all residual chlorine is completely flushed from the well. Total chlorine shall be tested and the results of the test noted on the sample submission form. Total chlorine shall be undetectable before total coliform sampling for microbiological samples. Two consecutive total coliform samples, at least thirty minutes apart, must be total coliform negative before the well can supply water for human consumption. It is preferred the samples be collected twenty-four hours apart. An Ohio EPA certified laboratory must be used for bacterial analysis.
6. If any of the bacterial samples taken from the well in step 5 are reported as total coliform-positive (unsafe), repeat step 1 through step 5.
7. If the water is reported as total coliform positive (unsafe) after repeating the procedure two times, contact the District Office.

NOTE: When calcium hypochlorite is used for disinfection, the tablets or granules shall be completely dissolved in water prior to placement into the well.

Sodium hypochlorite solution with fragrance additives shall not be used for disinfection.

3.11 Sealing of Wells That Are No Longer Used or Needed

3.11.1 Requirements

A well or dry hole whose use has been permanently discontinued, shall be properly sealed. A test hole that is not converted into a well upon completion of testing shall also be properly sealed. Sealing shall be in accordance with OAC Rules 3745-9-10 and 3745-9-07 and “The State of Ohio Regulations and Technical Guidance for Sealing Unused Water Wells and Boreholes.”

3.11.2 Procedure

Engage a qualified ground water professional, engineer or Ohio Department of Health registered well driller familiar with proper sealing procedures to perform or supervise abandonment of the well. The sealing procedure from OAC Rule 3745-9-10 for a non-artesian well that is constructed through a single aquifer is summarized below:

1. All obstructions shall be removed, including the pump and related equipment, drop pipe, pitless adapter, suction line, trash or other debris.
2. The casing shall be removed, ripped or perforated. Casing shall be removed if the annular seal is inadequate or water is flowing from around the outside of the casing. If none of these conditions are present the casing may be left intact or in-place with prior approval of the District Office.
3. If microbiological growth is present, the well shall be disinfected with sodium hypochlorite or calcium hypochlorite to achieve at least 50 mg/L total chlorine in the water column.
4. The well can be either entirely filled with bentonite or it can be filled with clean and disinfected sand or gravel in the bottom followed by a bentonite cap. If sand or gravel is to be used then it may be placed no higher than the top of the aquifer or 25 feet below the ground surface, whichever is lower.

Coarse grade bentonite can be used to seal wells that are larger than 4 inches in diameter and less than 200 feet deep. Pelletized bentonite can be used to seal wells that are larger than 4 inches in diameter and less than 100 feet deep. Wells that are either more than 200 feet deep or less than 4 inches in diameter will require special bentonite placement and the District Office should be consulted.

If the casing is to be removed, the sealing material and grout shall be placed concurrently with casing removal.

5. After the sealing material and grout have been placed into the well, the grout shall cure a minimum of twelve hours to assess whether any settling of the sealing material has occurred. If settling has occurred, additional grout shall be placed into the well.
6. Casing shall be removed to a depth of at least 3 feet below ground surface. The remaining hole should be filled with clean clay.
7. Obtain, complete and submit a uniquely numbered well sealing report to the Ohio Department of Natural Resources, Division of Soil and Water Resources. Also, submit a copy to the Ohio EPA District Office. A sample well sealing report is included in Appendix F.

3.12 Standards

Well sealing needs to be done in such a way that there can be no vertical movement of water either within the well borehole or in the annular space around the well casing.

Chapter 4 - Treatment

4.0 General

This section discusses disinfection, iron and manganese removal, and ion exchange softening. Any proposed treatment must conform to the guidelines of this publication.

Upon evaluation of chemical, microbiological and radiological test results, the District Office shall determine the need for additional treatment.

A separate room or building should be used for water treatment chemicals and equipment and should be accessible only to authorized personnel.

All chemicals, substances and materials added to or brought in contact with water or intended to be used in a public water system or used for the purpose of treating, conditioning, altering or modifying the characteristics of such water shall conform with the ANSI/NSF standards 60 and 61.

4.1 Detail Plan Approval Exemptions

Ground water noncommunity public water systems serving less than 250 persons are exempt from obtaining prior plan approval for the installation of cation exchange softeners and cartridge filters if all of the following conditions are met:

- 4.1.1 The public water system submits the following information, in accordance with OAC Rule 3745-91-02 (G):
 1. The equipment is certified to meet ANSI/NSF/CAN standards stated in OAC Rule 3745-83-01(D).
 2. For cation exchange softeners, the number and size of units, the system well capacities, the loading rate, the blending information and the method of brine disposal.
 3. For cartridge filters, the number of units, the system well capacities, the manufacturer and model number, whether the units are cleanable or disposable, and the manufacturer's capacity recommendation.
 4. The PWS does not have a raw water nitrate result greater than 5 mg/L or an inorganic result of greater than 80% of the MCL for applicable contaminants as defined in OAC Chapter 3745-81.

4.2 Disinfection

4.2.1 Requirements

All community public water systems and major noncommunity water systems (those serving 1,000 or more persons for any 60 days out of the year) must provide disinfection. Noncommunity public water systems (with storage or large or complex distribution systems), not required to provide disinfection, should consider the installation of a chlorination system. Gaseous chlorination should not be considered for small water systems and is not covered by this manual.

A public water system may be encouraged to install a chlorination system if its distribution system is determined to be the source of a persistent total coliform-positive issue. When a chlorination system is primarily used to eradicate total coliform bacteria in the distribution system, the public water system may not be required to provide detention time. A chlorine residual will have to be measured daily from the distribution system to ensure the chlorine concentration is maintained at a level to

adequately remove total coliform bacteria. Chlorination systems primarily used for the removal of total coliform bacteria are usually installed for temporary use.

4.2.2 Design Procedure for Hypochlorite Feed System

1. **Equipment:** A hypochlorinator feed system consisting of a solution tank and a small diaphragm pump with a four-way valve placed on the discharge side of the pump or a peristaltic type pump is used to inject a chlorine solution into the water. Injection ports should be 45 degrees from the bottom of the pipe and protrude 1/3 of the pipe diameter into the pipe. The pump must be selected to normally operate in the middle third of its range.

Feed Pump Output (GPD)	=	Well pump Output Rate (gpm)	x	Required Dosage (ppm)	x 1440	÷	Solution Strength (ppm)
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Tanks and appurtenances must be durable, corrosion-resistant material, protected against freezing and readily cleanable. The tanks must be provided with a cover and a means to measure the daily usage in the tank.

Redundancy of chlorination system components shall be provided for community and major noncommunity water systems, any system installing chlorination for ground water rule compliance, or for systems as required by the Director. Redundancy may include additional inline pumps, spare pump(s) in storage and/or additional pump components. Contact the District Office for more information.

2. **Chlorine Solution:** Chlorine solution can be prepared by one of the following methods:
 - a) Mix one gallon of sodium hypochlorite (5-1/4% chlorine) with 4 gallons of water in the solution tank. This will provide a solution of approximately 1% active chlorine (10,000 ppm). Three pints of commercial 15% sodium hypochlorite can be substituted for the gallon of sodium hypochlorite.
 - b) Dissolve one-half pound of dry calcium hypochlorite into 4-1/2 gallons of water using the solution tank. This will provide a solution of approximately 1% active chlorine.
3. **Installation:** Install hypochlorinator pumps to operate when the well pump operates. Alternatively, a flow-paced feed system may be required depending upon the system design. The injection point should be after any softener (if provided) and before the pressure and detention tanks. If the chlorinator is placed before the softener, compatibility between the softener resin and chlorine must be confirmed. Ideally, the chlorine concentration upstream of the softening system should be less than 1 mg/L.

Figures 5 and 6 illustrate typical chlorination installations.

4.2.3 Standards

1. **Detention time:** The detention tank must be sized and designed to permit a full 30 minutes for disinfection contact time. Chlorine contact time provided for iron oxidation may be credited toward the 30 minute minimum chlorine disinfection contact time. This shall be maintained prior to distribution. The chlorine contact tank should be baffled to minimize short circuiting, preferably with a large length to width ratio (i.e., 30:1).

An alternative to providing 30 minutes of disinfection contact time is to provide a minimum 4.0 log inactivation of viruses. Contact your District Representative for guidance.

A pressure tank that is connected to the main line by a single pipe is considered as floating on the system. This arrangement cannot be considered as providing chlorine contact time. Separate inlet and outlet pipes may be used to achieve contact volume.

2. **Chlorine Content:** During the detention period, a minimum free chlorine residual of 0.5 mg/L should be maintained.

In the distribution system a minimum free chlorine residual of 0.2 mg/L or a minimum combined chlorine residual of 1.0 mg/L shall be maintained.

The feed rate (pump setting) necessary to obtain the desired residual can be determined by experimentation using a digital DPD (N, N-Diethyl-p-Phenylene Diamine) chlorine test kit. The test kit must provide an electronic measurement of the color development and have a digital display of the result. The DPD test kit must have a method detection limit of 0.1 mg/L.

CAUTION: Hypochlorites are strong oxidants. Avoid storing oil or other combustible materials in the chlorination area.

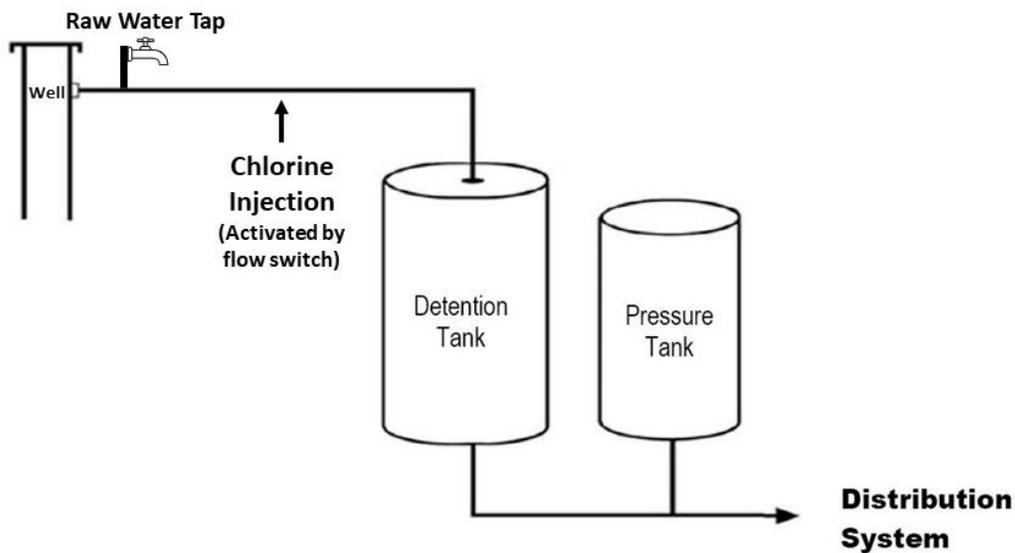


Figure 5 - Disinfection

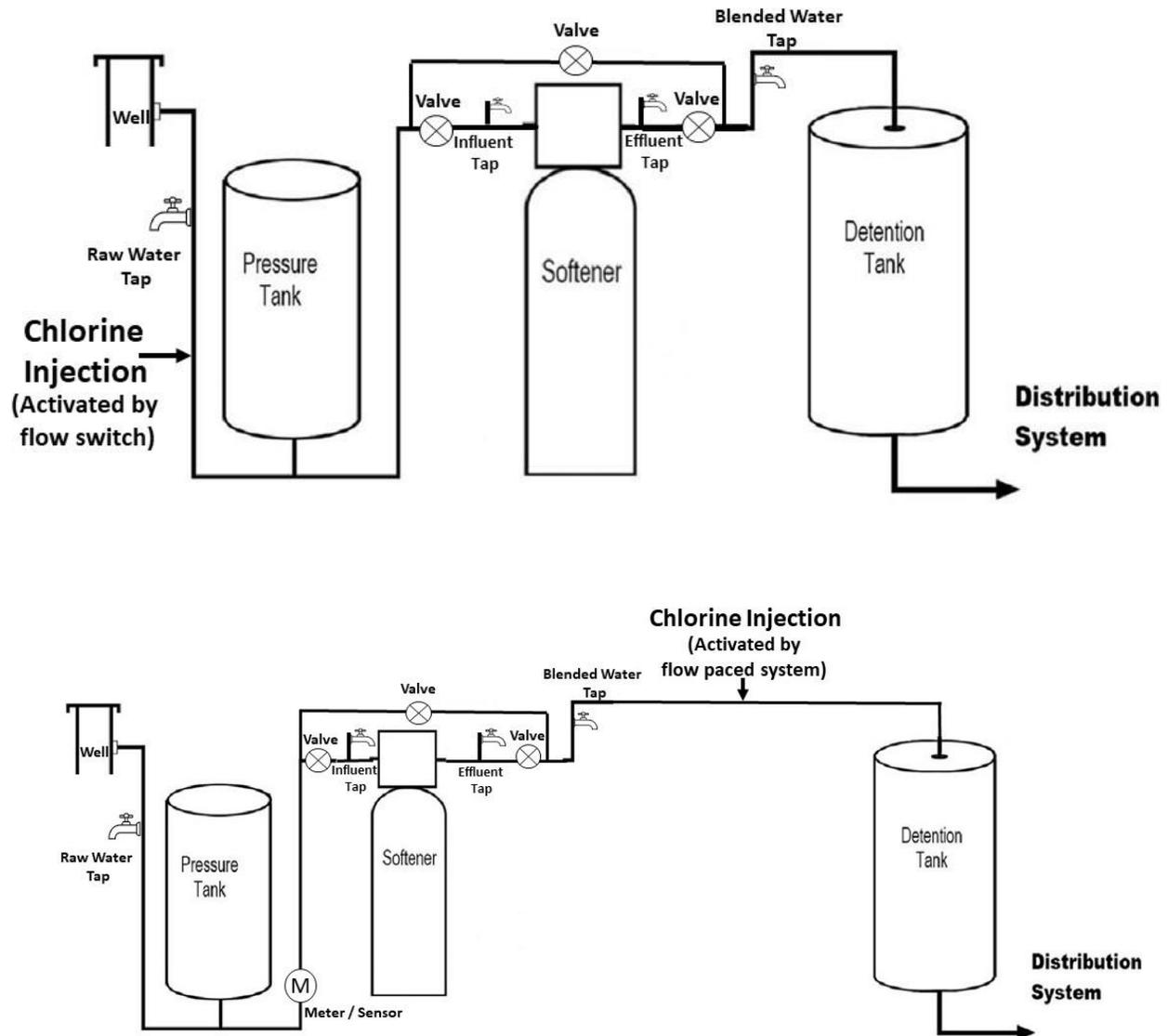


Figure 6 A & B - Disinfection with Cation Exchange Softening

Notes:

1. The piping between the well and the treatment system (typically a buried pipe) shall be maintained under system pressure at all times (OAC Rule 3745-9-05). A check valve or backflow preventer shall not be installed between a pitless adapter or pitless unit and the pressure tank.
2. The location of the pressure tank has to be considered. Installing it as the first component will provide for attenuation of potential water hammer produced by the well pump. Installing it at an intermediate location or as the last component will provide a defined flow rate, as generated by the well pump, for all the treatment or chemical feed equipment located before it.
3. Chemicals can be injected into the water system by using a simple flow switch (Figure 6. A) or a flow paced system (Figure 6. B). The flow switch uses preset thresholds to control when the dosing pump will operate; a fixed amount of chemical will be injected into the water system when using a flow switch to control the dosing pump. When using a flow paced system,

typically signals from a flow meter will alert the dosing pump to increase or decrease the amount of chemical injected into the water system.

4.3 Iron and Manganese Removal

4.3.1 Treatment Requirements

1. New community water systems shall provide treatment for removal of:
 - a) Iron to meet the secondary maximum contaminant level (SMCL) of 0.3 mg/L as set forth in OAC Rule 3745-82-02 when the level of iron in water entering the water plant exceeds the SMCL.
 - b) Manganese to meet the SMCL of 0.05 mg/L as set forth in OAC Rule 3745-82-02 when the level of manganese in water entering the water plant exceeds the SMCL.
2. Existing community water systems that make a substantial change in source or treatment shall provide treatment for:
 - a) Iron, if the level of iron at the entry point to the distribution system exceeds the SMCL set forth in OAC Rule 3745-82-02.
 - b) Manganese, if the level of manganese at the entry point to the distribution system exceeds the SMCL set forth in OAC Rule 3745-82-02.
3. New nontransient noncommunity water systems shall provide treatment for removal of manganese to meet the secondary maximum contaminant level at the entry point to the distribution system, if the level of manganese in the water entering the water plant exceeds 0.24 mg/L set forth in OAC rule 3745-82-02.
4. Existing nontransient noncommunity water systems that make a substantial change in source or treatment shall provide treatment for removal of manganese to meet the secondary maximum contaminant level set forth in OAC rule 3745-82-02 at the entry point to the distribution system should it exceed 0.24 mg/L at the entry point to the distribution system.

4.3.2 Finished Water Standards

Where removal treatment is required or provided, the finished water shall conform to the following:

1. The iron content shall be less than 0.3 mg/L.
2. The manganese content shall be less than 0.05 mg/L.

4.3.3 Treatment Methods

Remove iron and manganese by one of the following methods, as applicable. The flow diagrams in Figures 7 to 10 show typical iron and manganese removal installations. For all oxidation/filtration methods, the rate of reaction is pH-dependent.

1. **Aeration/Pressure Sand Filtration:** Aeration followed by filtration is an acceptable means for iron removal only. Aeration provides precipitation of dissolved iron through oxidation by the oxygen in the air. Public water systems required to provide iron removal to meet the SMCL, shall provide at least 30 minutes detention time after aeration. The detention time required may be lowered if another oxidant is used in conjunction with air. For more information on design requirements for various aeration processes, refer to Section 4.7 of Recommended Standards for Water Works (2018).
2. **Cation Exchange:** The use of cation exchange softening as a method of iron removal is limited by the following guidelines. Cation exchange is not recognized as approvable treatment for manganese for compliance with OAC 3745-91-09.

- a) This process of iron removal should not be used for water containing more than 0.3 milligrams per liter of iron, manganese or combination thereof since the mineral loading may compromise the efficiency of the softening system by fouling the resin.
 - b) This process is not acceptable where either the raw water or wash water contains dissolved oxygen or other oxidants exceeding the manufacturer's recommendations.
 - c) Pre-treatment is required when a combination of iron and manganese exceeds 1.0 mg/L for community and non-transient non-community systems or as recommended by manufacturer. Pre-treatment is recommended at this level for transient non-community.
3. **Chlorine Oxidation/Pressure Sand Filtration:** In general, this procedure is more applicable to the removal of iron than manganese. The procedure is to chemically oxidize the iron to its insoluble state by the use of chlorine, and then to remove the iron by filtration through a pressure sand filter. At least 20 minutes reaction time is to be provided for oxidation to occur. A pressure tank that is connected to the main line by a single pipe is considered as floating on the system. This arrangement cannot be considered as providing reaction time.
 4. **Chemical Oxidation/Manganese-Coated Sand Pressure Filtration:** Manganese-coated sand typically is regenerated using chlorine and/or permanganate fed continuously prior to the filter to assist with the removal of manganese and iron. In the continuous feed procedure, oxidation of manganese and iron occurs as the water interacts with chlorine and/or permanganate and with the manganese-dioxide coating on the sand.

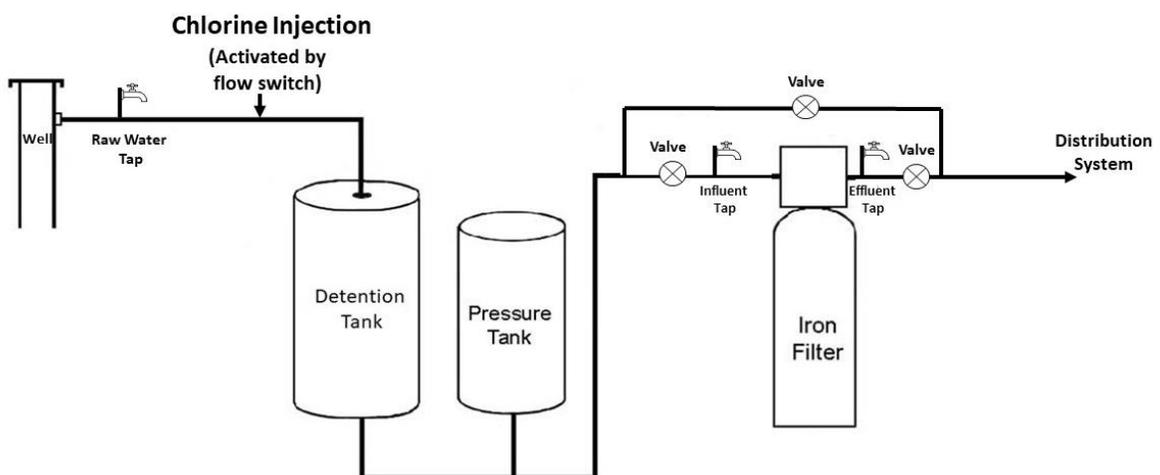


Figure 7 - Iron Removal

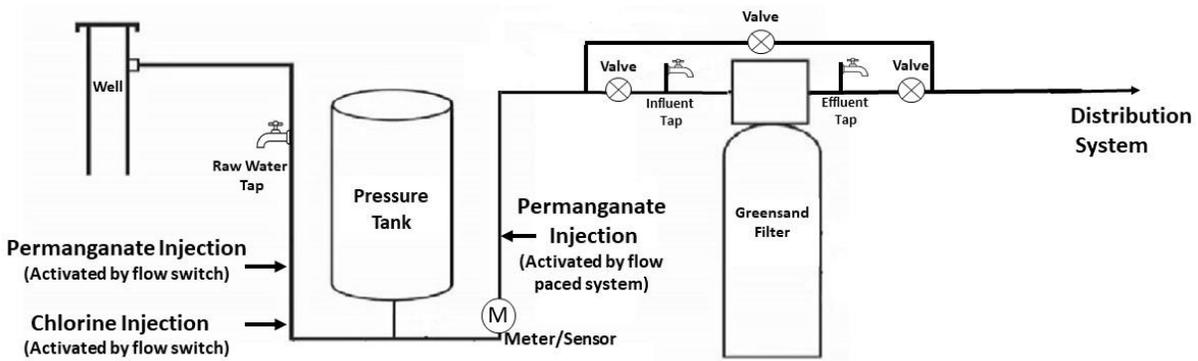


Figure 8 - Iron and Manganese Removal (Revised)

Notes:

1. The piping between the well and the treatment system (typically a buried pipe) shall be maintained under system pressure at all times (OAC Rule 3745-9-05). A check valve or backflow preventor shall not be installed between a pitless adaptor or pitless unit and the pressure tank.
2. The location of the pressure tank must be considered. Installing it as the first component will provide for attenuation of potential water hammer produced by the well pump. Installing it at an intermediate location or as the last component will provide a defined flow rate, as generated by the well pump, for all the treatment or chemical feed equipment located before it.
3. Chemicals can be injected into the water system by using a simple flow switch or a flow paced system. The flow switch uses preset thresholds to control when the dosing pump will operate (e.g., pressure settings); a fixed amount of chemical will be injected into the water system when using a simple flow switch. When using a flow paced system, typically signals from a flow meter will alert the dosing pump to increase or decrease the amount of chemical injected into the water system. A flow paced system is recommended to reduce the likelihood of overfeeding a chemical.

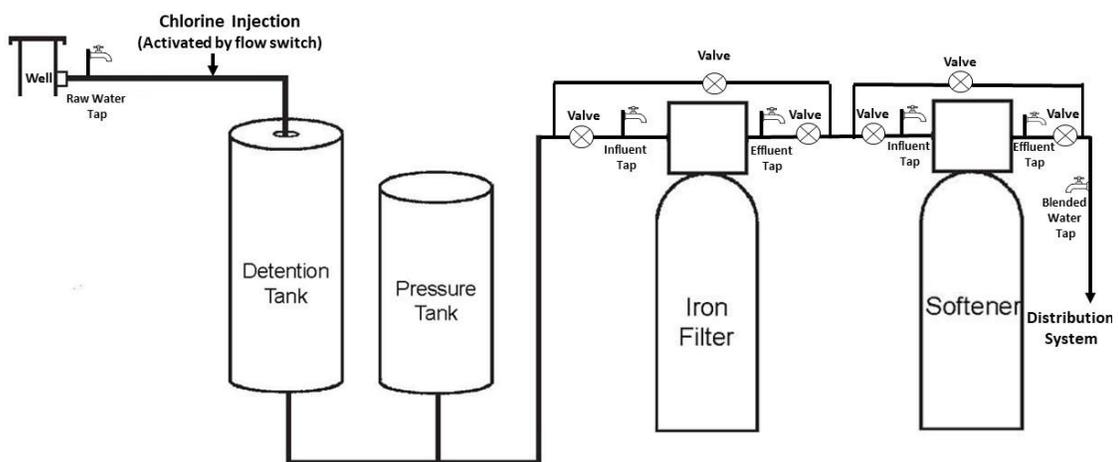


Figure 9 - Iron Removal and Ion Exchange Softening

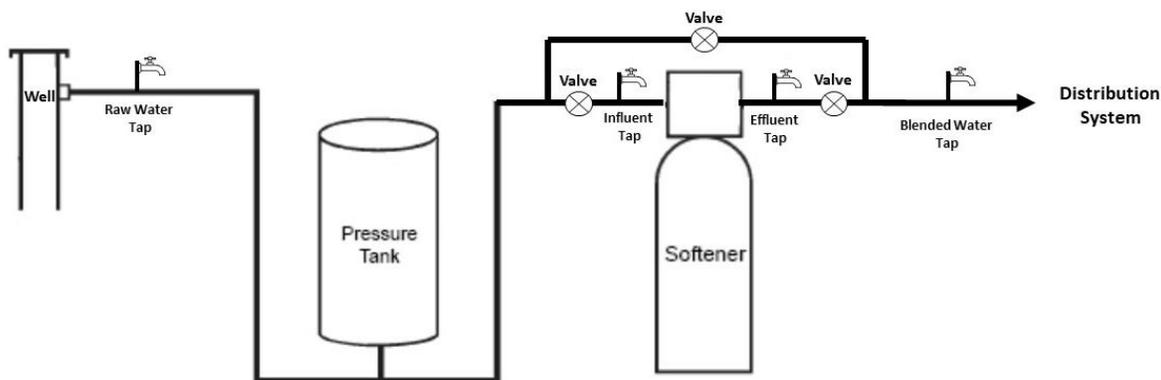


Figure 10 - Ion Exchange Softening

Notes:

1. The piping between the well and the treatment system (typically a buried pipe) shall be maintained under system pressure at all times (OAC Rule 3745-9-05). A check valve or backflow preventor shall not be installed between a pitless adaptor or pitless unit and the pressure tank.
2. The location of the pressure tank has to be considered. Installing it as the first component will provide for attenuation of potential water hammer produced by the well pump. Installing it at an intermediate location or as the last component will provide a defined flow rate, as generated by the well pump, for all the treatment or chemical feed equipment located before it.

4.3.4 General Filtration Standards

Pressure sand, manganese greensand and manganese-coated sand filter systems shall comply with the following general requirements:

1. Normal filtration rates should be between 3 gpm/sf and 5 gpm/sf. Higher filtration rates for alternative media may be permitted based on data submitted to the District Office. The District Office may require a pilot study to verify the filter will perform as designed under actual conditions at the water treatment plant.
2. Red water waste (backwash) shall be discharged to a sanitary sewer or through a red water filter. Red water filters are regulated by Ohio EPA's Division of Surface Water and may require NPDES permits. An overview of design requirements for red water filters is provided in Section 4.8. Contact Division of Surface Water for more information.
3. Drain lines for filter waste streams must terminate in an air gap (i.e., "free fall discharge") equal to at least two pipe diameters, but no less than one inch, above the flood rim of a floor drain.
4. A bypass should be provided around any and all filter units.
5. Sampling taps must be provided on each of the filter influent and effluent lines.
6. Each filter must have an air release valve and an access opening to facilitate inspection or repair.
7. Filters should be backwashed until the effluent is clear (typically 10 to 15 minutes), as necessary.
8. Filters should be backwashed consecutively when possible.

9. Testing equipment and methods acceptable to Ohio EPA shall be provided to measure iron and manganese.
10. Tanks subject to pressurization shall comply with ASME Code requirements or an equivalent requirement of the state and local laws and regulations for the construction and installation of unfired pressure vessels.
11. No piping may pass down through the filter media when treating for the removal of a primary contaminant to minimize the risk of short circuiting.

4.3.5 Pressure Sand Filtration Systems Standards

Pressure sand filtration systems shall comply with the following specific design standards:

1. Where aeration oxidation is used, at least 30 minutes detention time shall be provided. Where chlorine oxidation is used, this detention time shall be at least 20 minutes, unless justification is provided for a reduced detention time. This justification is based upon water chemistry and rate of oxidation. Detention shall be provided ahead of filtration to ensure more complete oxidation of the iron.
2. The filter media shall have a total depth of not less than 24 inches and generally not more than 30 inches.
3. Filter vessel dimensions shall provide 18 inches for bed expansion between the top of the washwater collectors and the surface of the media.
4. The filter sand shall have an effective size range of 0.45 mm to 0.55 mm and a uniformity coefficient no greater than 1.65.
5. A filter backwash rate of 15 to 20 gpm/sf shall be provided.

4.3.6 Pressure Manganese-Coated Sand and Manganese Greensand Filtration Systems Standards

Pressure manganese-coated sand and manganese greensand filtration systems shall comply with the following specific design standards:

1. For a continuous feed system, sampling taps shall be provided prior to application of permanganate and at the filter effluent. Sample taps should be provided halfway down the manganese greensand and at a point between the anthracite media and the manganese greensand. Two feed points are recommended for the permanganate. One point should be as far ahead of the filter as possible and the second point should be immediately ahead of the filter.
2. Other oxidizing agents or processes, such as chlorination, may be used. Aeration can be used in addition to a chemical oxidant.
3. An anthracite media cap having a minimum depth of 6 inches must be provided over manganese greensand. The anthracite media shall have an effective size of 0.8 mm to 1.2 mm and a uniformity coefficient no greater than 1.85.
4. Air scouring is recommended for all different types of filters.
5. Backwash rates shall be 8 to 10 gpm/sf for greensand, and 15 to 20 gpm/sf for manganese-coated silica sand for about 15 minutes, or until the backwash water runs clean. Different backwash rates are required for the two media due to the difference in effective size.

4.3.7 Other Available Media

Other media can be considered based upon proven performance with applicable water quality. Table 1 provides manufacturers' recommendations for commonly used media. Demonstration testing may be

required for filtration rates above 3.0 gpm/sf. Additional raw water quality information may impact the final design. Contact your District Office for additional information.

In most cases, manufacturer's design criteria will be accepted for treatment of secondary MCLs unless the District Office's experience determines other criteria or more stringent standards should be followed. Treatment for Primary MCLs and/or HALs is beyond the scope of this manual.

Table 1 - General Media Guidance

Type of Media	Media				Flow Through Rate (gpm/ft ²)	Anthracite			Backwash	
	Effective Size (mm)	Uniformity Coeff.	Bed Depth (in)	Density (lbs/ft ³)		Effective Size (mm)	Uniformity Coeff.	Bed Depth (in)	Velocity (gpm/ft ²)	Min Expan (%)
Pressure Sand	0.45 – 0.55	< 1.65	24 – 30	~100	3	N/A	N/A	N/A	15 – 20	Varies
Manganese Greensand	0.3 – 0.35	< 1.85	30	85	3 – 5	0.8 – 1.2	< 1.85	≥ 6" if used	8 – 10	40
Manganese-Coated Filter Sand	0.43 – 0.51	1.7 – 2.0	Varies	Varies	2 – 5	0.8 – 1.2	< 1.85	≥ 6" if used	Varies	Varies
Activated Manganese-Coated Filter Sand	0.48 – 0.59	1.96 – 2.71	30 – 36	44-50	3.5 – 5.0	N/A	N/A	N/A	10 – 12	20 – 40
Granular Manganese Dioxide Media	0.40 – 0.60	< 2.0	24 – 36	50-55	3 – 5	N/A	N/A	N/A	10 – 12	20 – 40
Manganese-Coated Sand	0.3 – 0.35	< 1.6	15 – 18 w/ anth. cap 24 w/o anth. cap	89	2 – 12 (demo req'd)	0.8 – 1.2	< 1.85	15 – 18	12	40
Non-Hydrous Silicon Dioxide	0.67	2.1	24 – 36	24 – 26	5	N/A	N/A	N/A	8 – 10	20 – 40
Ceramic Media	0.20 – 1.20	< 1.4	24 – 36	52 – 73	8 – 12	N/A	N/A	N/A	8	Varies

Type of Media	Constraints		Oxidation Requirements	Regeneration	
	pH	Practical Influent Conc.	Type Contact Time	Batch	Continuous
Pressure Sand			Cl ₂ : 20 minutes Air: 30 minutes		
Manganese Greensand	6.2 – 8.5	[H ₂ S] = 5 mg/L [Fe ⁺²] = 15 mg/L [Mn ⁺²] = 15 mg/L	MnO ₄ KMnO ₄ and/or chlorine or aeration	Manganese is primary target	Iron is primary target
Manganese-Coated Filter Sand	6.2 – 9.0	[H ₂ S] = 2 mg/L [Fe ⁺²] = 15 mg/L [Mn ⁺²] = 5 mg/L Other ¹	MnO ₄ and/or Cl ₂	Filters up to 3 ft ³	Filters over 3 ft ³
Activated Manganese-Coated Filter Sand		Alkalinity > 2 x ([SO ₄] ⁻² + [Cl]) Other ^{2,3}	Continuous MnO ₄ and/or chlorine or aeration. MnO ₄ added at and immediately before filter	N/A	N/A
Granular Manganese Dioxide Media	6.2 – 8.5	Other ¹		KMnO ₄ for 30 minutes	Cl ₂ or KMnO ₄ or both
Manganese-Coated Sand	6.2 – 8.5				
Non-Hydrous Silicon Dioxide	Wide range		Air: 30 minutes Cl ₂ : 20 minutes		
Ceramic Media					

¹No polyphosphates prior to filter ²No oils present ³No H₂S. Free chlorine < 0.5 mg/L

1. Manganese-Coated Filter Sand

Manganese-coated filter sand filtration systems shall comply with the following specific design standards:

- a) Manganese-coated filter sand is tolerant to waters that are low in silica, TDS and hardness. It is primarily used for removing soluble iron, manganese, hydrogen sulfide, arsenic and radium from ground water sources.
- b) Chlorine or another strong oxidant should be fed at least 10-20 seconds up stream of the filter, or as far upstream as possible to ensure adequate contact time. A free chlorine residual carried through the filter will remain in the media in a continuously regenerated condition.
- c) Manganese-coated filter sand is generally used in a dual media bed type with a minimum of 15 inches of manganese-coated filter sand and 15 inches of anthracite.
- d) After initial placement of the manganese-coated filter sand into the filter basin, the media must be sufficiently backwashed prior to adding the anthracite cap to ensure fine grains are removed. After backwashing, the media must be conditioned with chlorine to provide activation.
- e) The water in contact with the media should have a pH in the range of 6.2 and 8.5.
- f) The filter sand should have an effective size range of 0.3 mm to 0.35 mm and a uniformity coefficient no greater than 1.6.
- g) A minimum filter backwash rate of 12 gpm/sf should be provided.

2. Activated Manganese-Coated Filter Sand

a) Description

Activated manganese-coated filter sand is a manufactured media using sand or other base media as the substrate. A manufactured coating over the substrate provides the actual contaminant removal or serves as a catalyst to enable physical removal through filtration. The manufactured coating is specific to the filter media manufacturer and the intended contaminant removal.

b) Design Criteria

Due to the variability between similar products, universal design criteria are not easily developed. In general, the following criteria will be followed:

1. Filtration rates shall not exceed the manufacturer's maximum rate. In general, a rate of 3 to 5 gpm/sf should be the maximum target rate.
2. Filter media bed depth should be 30 inches at a minimum.
3. Sample taps for raw water, filter influent and filter effluent must be provided.
4. Backwashing of the filter media must meet manufacturer's minimum requirements.
5. For media types requiring periodic chemical regeneration, provisions for this chemical feed must be provided. Regeneration must meet manufacturer's minimum requirements. A procedure for regeneration shall be included in the facility's asset management program.

6. Pre-treatment may be required to meet filter media operating parameters. This may include the following:
 - a) Aeration to ensure minimum dissolved oxygen is maintained.
 - b) Chlorine removal or chlorine addition.
 - c) pH adjustment.
 - d) Oil and polyphosphate removal.
 - e) Removal of raw water parameters detrimental to the filter media. These may include sulfates, chlorides, alkalinity, and background bacterial or organic content.

c) **Backwash disposal**

All backwash water and regeneration wastes shall be disposed in an acceptable manner. Please refer to Section 4.8 for more information.

d) **Operations**

Raw and treated water should be periodically checked for key operational parameters to ensure media performance is maintained. It is recommended that a water meter be provided to determine treatment capacity for each specific installation.

3. **Non-Hydrous Silicon Dioxide Media**

- a) Non-hydrous silicon dioxide filter media is often used for the reduction of suspended matter and can be considered for iron removal. Manganese removal with non-hydrous silicon dioxide filter media requires a successful pilot study.
- b) These filtration systems shall comply with the following specific design standards:
 1. An appropriate oxidant must be used ahead of the filter.
 2. A filter media depth of 24 to 36 inches is recommended. If an anthracite cap is used, a media depth of 12 to 24 inches is recommended with an anthracite cap of 12 to 24 inches. The total bed depth should not exceed 36 inches.
 3. After initial placement of the media into the filter, the media must be sufficiently backwashed prior to adding anthracite cap to remove the fines.
 4. The filter sand shall have an effective size of 0.67 mm and uniformity coefficient no greater than 1.8.
 5. A minimum filter backwash rate of 10 gpm/sf shall be provided.

4. **Ceramic Media**

Ceramic filter media can be used for the removal of iron, manganese and other contaminants. It is available in several effective sizes ranging from approximately 0.20 mm to 1.20 mm. Uniformity coefficients typically are about 1.3 or 1.4. Piloting studies are recommended for media selection and design performance validation.

- a) Vessels are usually down flow, configured with 24 to 36 inches of ceramic filter media. One or more sizes of ceramic media may be contained within the pressure vessel.
- b) Loading rates typically range from 8-12 gpm/sf.
- c) A diffusion system is required at the top of the vessel and a collection system is required at the bottom of the vessel. The diffusion and collection systems are intended to ensure the even passage of water through the media. The primary purpose of the upper diffuser is to distribute the influent water evenly over the surface of the media. If a slot-type diffuser is used, the slot opening must be large enough to allow coagulated solids to escape the vessel during backwash.

The collection system at the bottom of the vessel must be designed to retain the ceramic filter media within the pressure vessel.

5. **Small Bag and Cartridge Filters**

Bag and cartridge filters are often installed upstream of small ion exchange units to increase the longevity of treatment.

A water system may be exempt from applying for plan approval regarding the installation of these filters. (See Section 4.1)

The following are requirements for all bag or cartridge filters:

- a) The filter housings and filter cartridges/bags must be approved in accordance with OAC Rule 3745-83-01(D).
- b) Spare filter cartridges should be kept on site. Routine maintenance is required on the filter and assembly. The date of any filter cartridge cleaning or replacement must be noted in the operating record.

Proper cleaning procedures, according to manufacturer's standards, must be followed during filter cleaning or replacement.

4.4 **Cation Ion Exchange Softening**

4.4.1 Requirements

Ohio EPA does not require that water be softened. The acceptable level of hardness depends upon the experience and the requirements of the water consumers.

The blended water delivered to the distribution system should have a total hardness of at least 80 mg/L (5 grains/gallon) expressed as CaCO₃. The recommended range for finished water hardness is 120 mg/L to 150 mg/L (7 to 9 grains/gallon) expressed as CaCO₃.

For community and nontransient noncommunity water systems, if blending results in an exceedance of the SMCL for iron or manganese levels, iron and manganese removal prior to softening will be required.

When ion exchange is used for iron removal, see Section 4.3 of this document.

4.4.2 Procedure

The procedure is to exchange the hardness-causing ions, calcium and magnesium in the water with sodium in the salt-brine regenerated resin. The amount of sodium added to the water may be important to those on restricted or low sodium diets. Figures 9 and 10 show typical ion exchange softening installations.

1. The rate of softening should not exceed 7 gpm/s.f. or 3.5 gpm/s.f. Design of the ion exchange softening system shall conform to the following standards: ft³ of resin. Higher softening rates may be accepted by the District Office if proper documentation is submitted.
2. The backwash rate should meet the manufacturer's recommended standard backwash rate or a minimum of 6 gpm/ft²
3. The design capacity of hardness removal should not exceed 20,000 grains/ft³ when the resin is regenerated with 0.3 pounds of salt per kilograin of hardness removed.
4. Drain lines for brine streams must terminate in an air gap (i.e., "free fall discharge") equal to at least two pipe diameters, but no less than one inch, above the flood rim of a floor drain.

5. A bypass must be provided around each softening unit to produce a blended water as well as to provide operation of this system when the unit is out of service. Flow meters should be provided on blending bypass lines to allow control of the blending rate.
6. Smooth-nose (no threads on the spigot) sampling taps must be provided for the collection of representative samples. Taps shall be located to provide sampling of each softener's influent, effluent and blended water.
7. Brine measuring or salt dissolving tanks must be covered and constructed of corrosion-resistant material.
8. Suitable disposal must be provided for brine waste. (See Section 4.8.)
9. Tanks subject to pressurization shall comply with ASME Code requirements or an equivalent requirement of state and local laws and regulations for the construction and installation of unfired pressure vessels.

4.5 Additional Treatment Methods

Treatment methods such as arsenic and radiological removal, reverse osmosis and ultraviolet light for inactivation credit are not discussed in this document. The Ohio EPA recognizes the existence of alternative methods for treating contaminants not yet regulated by the Safe Drinking Water Act. The following sections discuss two of these methods:

4.5.1 Hydrogen Sulfide Removal through Oxidation and Filtration.

1. Description

Hydrogen sulfide removal can be achieved through oxidation and filtration of the oxidized contaminant. Oxidation can be achieved through pretreatment with air through a venturi valve, chlorine injection or hydrogen peroxide injection. Typically, a detention tank(s) follows oxidant injection. Filters are typically utilized after oxidation to filter out oxidized particulates. Activated carbon filters must be utilized when hydrogen peroxide is used as an oxidant. Due to the variability of hydrogen sulfide, overfeeding of the oxidant is typical to ensure complete oxidation is achieved. This section does not address oxidation and/or carbon filtration for the purpose of removing VOCs or other primary contaminants.

2. Design criteria

Oxidant addition can be done through a variety of means, including venturi-type valves or compressors for air addition, or metering pumps for sodium hypochlorite or hydrogen peroxide addition. The design of the treatment system should take the following items into consideration:

- a) The method for injecting air must be sanitary and must have a wide range of dosing capacity to ensure the maximum demand for hydrogen sulfide can be met. The venturi assembly must be maintained within sanitary conditions.
- b) The chlorine feed system should have capacity to meet the maximum demand of the hydrogen sulfide.
- c) The hydrogen peroxide feed system should have capacity to meet the maximum demand of hydrogen sulfide. Typically, a hydrogen peroxide: hydrogen sulfide ratio of 1:1 (on a mass basis) should be provided at a pH of 7.0, and increase as the pH increases.
- d) Adequate contact time should be provided before the carbon filter. Typically, a 20-minute contact time is needed to ensure complete oxidation of all contaminants.

- e) When carbon filters are required, the capacity of the carbon filter should be such that it will not need to be replaced for at least six months, to ensure adequate continuous operation. It may be necessary to provide a larger capacity for hydrogen peroxide systems for safety concerns. The use of air as an oxidant may require an accelerated replacement of carbon filter media.
- f) Sample taps must be provided before and after the carbon filter to enable appropriate monitoring of the carbon performance. It is recommended a flow meter be installed before the carbon filter.
- g) Backwash provisions may be required dependent upon raw water quality.
- h) Systems required to carry a chlorine residual in the distribution system must provide a second chlorinator after the carbon filter. Thirty minutes of detention time is required after the second chlorinator.
- i) Corrosivity can be significantly impacted with hydrogen peroxide or aeration due to the increased levels of dissolved oxygen in the distribution system. This must be taken into account with the system design, particularly if the water system is a community or nontransient noncommunity public water system. Carbon filters may be required by the Director.
- j) Hydrogen peroxide solution should be stored in a solution tank made of compatible material, typically polyethylene. Appropriate feed pump materials must be provided. Secondary containment for the solution tank must be provided. Due to the flammable nature of hydrogen peroxide, flammable materials (wood, paper, oil, cotton, leather gloves, etc.) should also not be stored near the solution tank. Organic materials (glycerol, alcohol, acetone, etc.) should not be stored near hydrogen peroxide due to explosion concerns.
- k) Adequate ventilation should be provided for hydrogen peroxide feed systems.

4.5.2 Ultraviolet Light Not Intended for Primary Inactivation

Ultraviolet light systems covered by this publication are Class B type systems. They are designed for supplemental bactericidal treatment of disinfected public drinking water, or other drinking water that has been tested and deemed acceptable for human consumption by the Ohio EPA.

Class B systems are designed to reduce normally occurring, nonpathogenic nuisance microorganisms only. Ohio EPA does not recognize these UV systems as adequate for the disinfection of microbiologically unsafe water, to provide disinfection credit, or to achieve MCL compliance. UV systems for the treatment of *E. coli* or fecal contamination (*Giardia*, *cryptosporidium*, and/or viruses) are outside the scope of this publication.

Ultraviolet light systems shall comply with the following specific design standards:

- a) The Class B UV system is required to deliver a minimum UV dose of 16 mJ/cm² that is sufficient to inactivate nonpathogenic organisms.
- b) UV systems must meet ANSI/NSF 55 standards. Class A UV systems may be used in lieu of Class B systems; however, inactivation credit will not be granted.
- c) Pre-treatment may be required dependent upon raw water quality and the manufacturer's recommendation.
- d) Routine cleaning and maintenance is required.

4.6 Corrosion Control

Technical recommendations to help community and nontransient noncommunity public water systems comply with corrosion control treatment (CCT) requirements of the Lead and Copper Rule (LCR), including designation of optimal corrosion control treatment (OCCT) can be found in the U.S. EPA Optimal Corrosion Control Treatment Evaluation Technical Recommendations for Primacy Agencies and Public Water Systems, EPA 816-B-16-003, March 2016 (Updated 2019). Community and nontransient noncommunity water systems are triggered into corrosion control treatment (CCT) evaluation when any substantial change in source or treatment is proposed, in accordance with OAC Rule 3745-81-81(F).

Guidelines for Determining When Source or Treatment Changes Trigger Optimal Corrosion Control Evaluation (ENG-9119-GD) was created to provide guidance on the potential associated risk to corrosivity for a substantial change at a public water system and the CCT evaluation required. For substantial changes in source or treatment, this evaluation may require water quality parameter monitoring, a CCT recommendation, and/or increased Lead and Copper monitoring. Please refer to ENG-9119-GD for specific requirements based on the proposed source and/or treatment changes. If the CCT evaluation shows that optimal corrosion control treatment is warranted, then detail plans for and the installation of treatment will be required.

Regardless of the system is currently in compliance with the lead and copper rule, if a system proposes a source or treatment change then it must:

1. Notify Ohio EPA of the intent to make a source or treatment change.
2. Submit detail plans for the proposed change.
3. Collect baseline WQPs and complete or update a CCT recommendation, study or plans as required. Note: Ohio EPA may require the CCT evaluation to be completed prior to detail plan submittal or approval.
4. Notify Ohio EPA when the source or treatment change is made or installed, as required under OAC Rule 3745-81-90(C)(4).
5. If proposed changes are made or treatment is installed, complete two 6-month water quality parameter (WQP) monitoring periods and two 6-month lead and copper tap monitoring periods, as applicable in accordance with OAC 3745-81-86(D)(2) and 3745-81-87(C).

4.7 Waste Disposal

All waste handling facilities must be reviewed and approved by Ohio EPA's Division of Surface Water. A separate permit-to-install application and/or NPDES permit may be required.

4.7.1 Requirements

As indicated in previous sections, provisions must be made for proper wastewater disposal from water treatment facilities. Stringent requirements may be necessary in order to meet the current stream standards.

Permit-to-install (PTI) applications must be filed and obtained prior to any construction of the wastewater disposal system. A National Pollutant Discharge Elimination System (NPDES) permit will be required if there are any wastewaters discharged to waters of the State.

Consult Ohio EPA's Division of Surface Water if you are uncertain about your situation. All disposal methods must be approved by the Division of Surface Water of the appropriate District Office before the Director can approve the proposed drinking water facilities which result in the new or modified waste stream.

Some local health Departments have been delegated authority to approve new onsite sewage systems up to 1000 gpd. The Ohio Department of Health, Environmental Health Section, maintains a list of health departments with this authority.

Contact the District Office early in the planning phase to assure that the proposed wastewater treatment and disposal options are acceptable. Failure to do this may result in delays of the project.

4.7.2 Procedures

The following are minimum requirements. Ohio EPA's Division of Surface Water may require more stringent designs in order to reliably and consistently meet discharge limits.

1. **Sanitary Waste:** Any sanitary waste from restrooms, shower facilities, etc. must be disposed of using good engineering practice by one of the following methods:
 - a) Discharge to an approved municipal sanitary sewer system.
 - b) Discharge to an approved onsite sanitary waste treatment facility designed in accordance with the recommendations shown in the booklet "Sewage Collection, Treatment and Disposal Where Public Sewers Are Not Available," and "Interim Onsite Sewage Treatment System Guidance Document," published by Ohio EPA's Division of Surface Water.
2. **Iron Removal Filter Backwash:** Backwash water from iron and/or manganese removal must be disposed of by one of the following methods:
3. **Discharge to Sanitary Sewer:** Backwash water can be discharged to sanitary sewers. However, approval must be obtained from the owner of the sewage treatment system and possibly Ohio EPA's Division of Surface Water. A flow equalization tank may be appropriate to provide uniform discharge to the sewage treatment plant. A PTI from the Division of Surface Water will need to be obtained for this flow equalization tank system.
4. **Discharge Through an Approved Red Water Filter:** Red water filters shall meet the following design criteria:
 - a) Total filter area shall be at least 100 square feet. The volume above the sand, with one red water filter cell out of service, shall be no less than the entire volume of backwash resulting from the consecutive washing of all filter units at one time. A lesser area may be approved where presettling is provided, the flow to the red water filters is regulated, or where a maintenance plan can ensure that all cleaning and rebuilding can be completed between backwash cycles. No more than 2 feet of backwash water shall accumulate over the sand surface.
 - b) The filter media shall consist of a minimum of 12 inches of sand supported on 3 inches of small gravel and 9 inches of gravel in graded layers.
 - c) Filter sand shall have an effective size of 0.3 mm to 0.5 mm and a uniformity coefficient not to exceed 3.5. Clean washed media shall be used.
 - d) Overflow devices shall not be permitted.
 - e) The location of the sand filters and the design of the under-drainage system shall be such that water supply wells are not contaminated.
 - f) Adequate freeboard shall be provided.
 - g) An NPDES permit and PTI will be required.
 - h) The filter must be constructed to provide for routine cleaning.

4.7.3 Brine Waste

The following are minimum requirements. Ohio EPA's Division of Surface Water may require more stringent designs in order to reliably and consistently meet discharge limits.

1. **Discharge to a Sanitary Sewer:**

Brine water may be able to be discharged to sanitary sewers with approval from the owner of the sewage treatment system and possibly Ohio EPA's Division of Surface Water. A flow equalization tank approved through a PTI may be necessary to provide uniform discharge to the sewer or sewage treatment plant.

2. **Controlled Discharge to a Stream:**

Brine water can be discharged to a stream if the flow is controlled and if adequate dilution flow is available in the stream during low flow conditions. A brine waste flow equalization tank approved through a PTI sized to provide 20 to 24 hours of uniform discharge to the stream may be required. Stream standards for total dissolved solids must be met. A separate NPDES permit from Ohio EPA's Division of Surface Water is required. The Division of Surface Water recommends preliminary wastewater discharge limits be considered as part of the initial evaluation of water treatment technologies.

3. **Discharge to a Separate Leaching Type Sewage Disposal System:**

Brine water can be discharged to leaching type sewage disposal systems if adequate dilution with the sanitary waste is available to prevent contamination of the ground water. Normally the diluted concentration of chlorides should not exceed 250 mg/L. A flow equalization tank may be necessary to provide uniform flow and dilution to the disposal system. Typical maximum allowable flow is 1,000 gpd for a leaching type sewage disposal system. A separate permit is required by Ohio EPA's Division of Surface Water.

If brine waste greater than 2500 gallons per month is generated, a permit must be obtained for a Class V Injection Well in accordance with OAC Chapter 3745-34.

4.7.4 Standards

1. **Sanitary Waste:** Onsite sanitary waste discharges shall conform to standards established and maintained by Ohio EPA's Division of Surface Water.
2. **Red Water Filter Effluent:** Effluent from a red water filter shall meet all the requirements in the NPDES permit.
3. **Brine Discharge:** Controlled brine discharge to a stream shall meet all requirements in the NPDES permit.

Chapter 5 - Storage

5.0 General

Storage (and pumping facilities) shall be adequate to maintain a minimum pressure of 20 psi throughout the distribution system at all times. The normal working pressure in the distribution system should be approximately 60 to 80 psi and not less than 35 psi.

Storage may take the form of a clearwell, a ground level tank or an elevated tank. Hydropneumatic tanks are not considered as a form of storage, but rather as a form of pressure regulation, and are included here for the sake of convenience.

Where well capacity is less than peak hourly demand (ten times the average daily demand), storage will be required to meet system demand. (See Section 3.4)

Storage structures shall follow current AWWA and ASTM standards whenever applicable. Storage structures shall be disinfected and proven bacterially safe prior to being placed into operation. A 24-hour contact period using 50 ppm free chlorine solution is one acceptable method. AWWA Standard C-652 lists other acceptable methods.

Fireflow requirements established by the Department of Insurance State Insurance Services Office should be met which is beyond the scope of this document.

5.1 Clearwell Storage

Clearwell storage shall meet the same standards, as those for ground level storage, except for Section 5.3. In addition, clearwell storage shall be sized to provide uniform, constant-rate filter operation. The clearwell shall be designed to provide the appropriate chlorine contact time, where disinfection is required, and shall be designed with two independent compartments.

5.2 Ground Level Storage

5.2.1 General Standards

1. The bottom of the tank shall be above the normal ground water table and the maximum flood level.
2. Any access or pipe connection shall be at least 3 feet above the 100-year flood elevation (does not apply to clearwell storage).
3. The tank shall be constructed no closer than 50 feet to sewers, drains, standing water and other sources of pollution.
4. The tank shall be watertight and constructed to prevent entry of birds, animals, insects and excessive dust.
5. Security shall be provided by fencing, locks and other measures as required to prevent trespassing, vandalism, sabotage and acts of terrorism.
6. The tank shall not have a direct connection to a sewer or storm drain.
7. A 24 mesh corrosion resistant screened vent shall be provided and terminate in an inverted "U" at least 24 inches above ground level. For standpipes, vents shall, open downward, and be fitted with either four mesh non-corrodible screen, or with finer mesh non-corrodible screen in combination with an automatically resetting pressure-vacuum relief mechanism, as required by the reviewing authority.

8. A minimum 24 inch diameter access manhole shall be located above the waterline and should be elevated not less than 24 inches above the surrounding ground level. The access manhole shall be fitted with a solid rain proof, locked cover which overlaps the framed opening and extends down at least 2 inches. Also curbs above the top of the tank shall be provided around any access or penetration into the top slab and shall be at least 4 inches high.
9. A 24 mesh corrosion resistant screened overflow must be installed so as to have a minimum air gap of 12 inches above a splash block located at the ground surface. Four-mesh corrosion resistant screen may be used on standpipes in place of 24-mesh to mitigate potential screen damage during an overflow. The overflow shall not connect directly to a sewer or storm drain.
10. Final grading shall be carried out so that surface water drains away from the tank.

5.2.2 Fiberglass Tank Standards

Fiberglass storage tank installations shall have the following exceptions and additions to the above:

1. General standards in 5.3.A.1, 5.3.A.5 and 5.3.A.9 do not apply to fiberglass storage tank installations.
2. Tanks should be pressure tested according to manufacturer's instructions and fittings tested for leakage before installation.
3. Tanks shall be anchored to a concrete pad and backfilled with pea gravel, with clean and free flowing 1/8" to 1/2" diameter stone crushings meeting ASTM C-33, or other backfill material meeting manufacturer's recommendations.
4. Combined weight of the empty tank, the concrete pad and the backfill supported on the concrete pad shall be sufficient to prevent flotation of the empty tank.

5.3 Elevated Storage

Elevated storage should be provided for systems serving more than 500 people or where usage exceeds 50,000 gpd. Storage of at least 100 gallons per capita is recommended.

5.3.1 Standards

Elevated storage tanks shall conform to the following:

1. The tank shall be constructed in accordance with the applicable AWWA Standards including D-100.
2. The tank shall be painted in accordance with AWWA Standard D-102, where applicable.
3. The tank shall be disinfected in accordance with AWWA Standard C-652.
4. Proper protection shall be given to metal surfaces by paints or other protective coatings, by cathodic protective devices or by both.

5.3.2 Design Criteria

1. The operating head range of the tank is not to exceed 30 feet.
2. The tanks shall be provided with a 24 mesh corrosion resistant screened overflow which discharges at an elevation of 12" to 24" above the ground surface over a drainage inlet or splash plate.
3. The tank shall include minimum 24 inch diameter entrance manholes with locked hatches and an OSHA approved access ladder. Vents shall, open downward, and be fitted with either four mesh non-corrodible screen, or with finer mesh non-corrodible screen in combination with an automatically resetting pressure-vacuum relief mechanism, as required by the reviewing authority.

4. A valving arrangement shall be provided to allow the tank to be removed from service.
5. A means to isolate and drain the tank shall be provided; a hydrant may be used for this purpose.
6. Security measures shall be provided including a locking chain-link fence, area flood lights, aircraft warning lights, etc., as appropriate.
7. Low/high level warning lights and/or alarms shall be provided.
8. A suitable control system shall be provided (e.g., telemetering) to ensure a minimum of 25% water exchange per drain/fill event.

5.4 Hydropneumatic Tanks

Hydropneumatic tanks are considered primarily as an electrical pump control/pressure control mechanism and not as storage.

5.4.1 Standards:

Hydropneumatic tanks and their installations shall conform to the following:

1. The drawdown volume of the hydropneumatic tank(s) should be such as to provide a minimum of 3 minutes run time of the largest supplying pump or combination of pumps or sized to allow the pump(s) to run for at least the pump manufacturer's recommended minimum run time. A hydropneumatic tank with a gross volume of at least ten times the capacity of the largest supplying pump(s) should be sufficient to meet this requirement.
2. The tanks shall not be buried, nor be located in an underground vault.
3. The tanks shall be completely housed and heated for protection from both physical damage and freezing.
4. The tanks shall be provided with a bypass to permit operation of the system when the tanks are out of service.
5. The tanks shall be provided with a drain, a pressure gauge, an air blow-off, a means of adding air, a pressure-activated off/on switch to control the supply pump and with a sight glass, where appropriate.
6. Tanks of 1,000 gallons capacity and larger shall be provided with at least a 24 inch by 18 inch elliptical manhole.

5.5 Constant Pressure Systems

Methods available to control water pressure in these types of systems include specially-designed control valves and the use of variable speed drives, also known as variable frequency drives (VFDs).

5.5.1 Variable Frequency Drives

Water systems using a VFD are capable of providing constant pressure over a fairly broad range of flow rates. As the water demand changes, the VFD electronically changes the speed of the pump motor to meet the change in demand without varying output pressure. Generally, controlled start-up and shut-down pumping rates can also be realized with VFDs, which helps reduce rapid pressure changes within the distribution system that potentially cause water hammer. The design of well pumps or high service pumps which utilize VFDs should ensure design average daily demand and peak hourly demand flowrates can be attained with the selected pump at the target pressure range or design pressure point. Power requirements and repair skills of the water system staff should also be considered.

5.5.2 Surge Tanks

Conventional pressure tank sizing, as shown in Section 5.5, is not applicable to VFD systems. Smaller sized pressure tanks or surge tanks are commonly required to prevent water hammer and provide immediate pressure prior to the pump start up. Follow manufacturer's specifications regarding the sizing requirements for surge tanks when VFD pumps are used.

Chapter 6 - Distribution

6.0 Plan Submittal

Plans of the distribution system shall ordinarily be submitted with the plans for the source, treatment and storage facilities, when such facilities are also proposed or required.

Plans for distribution system extensions must show that the existing source, treatment and storage facilities are adequate for the proposed increase in water usage.

6.1 Standards

6.1.1 Sizing

The distribution system shall be sized and designed to provide a minimum pressure of 20 psi at any point in the system at all times.

Typically, the normal working pressure in the distribution system should be approximately 60 to 80 psi and not less than 35 psi. The normal working pressure should be at least 30 psi for noncommunity systems when using pressure tanks for pump control and pressure regulation. Community systems using atmospheric storage for pressure regulation or for high service pump supply should provide a normal working pressure of at least 50 psi and also be capable of meeting fireflow at 20 psi when fire hydrants are provided. The peak demand on the system may vary considerably according to the nature of the development.

Water mains for providing fire protection and serving fire hydrants shall be a minimum of 6 inches in diameter. Adequate flows and pressures must be available for the approval of fire hydrants.

Consideration should be given to future water usage when sizing the distribution system.

6.1.2 Material

Pipe, fittings, valves and fire hydrants shall conform to the latest standards for drinking water issued by ASTM, AWWA and ANSI/NSF, where such standards exist, and be acceptable to the reviewing authority.

In the instance of PVC pipe under 4 inches in diameter, and while an AWWA standard on the subject is unavailable, the thinnest permissible material size is SDR-26.

Materials shall be certified as conforming to ANSI/NSF Standard 60 or 61 in accordance with OAC Rule 3745-83-01(D).

6.1.3 Valving

Valving should be provided within the distribution system to permit repair to the system with minimal disruption of service. The number and location of valves will depend on the nature and layout of the distribution system. Valving should be provided at all junctions so that the number of valves is no less than the number of lines at the junction minus one.

6.1.4 Flushing Hydrants

Flushing hydrants shall be provided at dead ends for systems not provided with fire hydrants. Hydrants should be sized to provide a minimum velocity of 2.5 feet per second in the water main.

6.1.5 Freeze Protection

Water lines shall be installed at a depth sufficient to provide protection from freezing. Although this depth may vary depending on location, in general, the minimum depth in Ohio should be 48 inches. The distance shall be measured to the crown of the pipe.

Water systems seeking lesser frost depth can refer to and cite Ohio Building Code frost line value for a specific project location.

6.1.6 Parallel Installation of Water/Sewer Lines and Manholes

Water mains shall be laid at least 10 feet horizontally from any existing or proposed gravity sewer, septic tank, leach field and/or subsoil treatment system. The distance shall be measured edge to edge.

No water mains should be closer than 10 feet from any sewer manhole and in no event shall a water main pass through or come into contact with any part of a sewer manhole. The distance shall be measured edge to edge.

6.1.7 Crossings of Waterlines/Sewers

Water mains crossing sewers shall provide a minimum vertical distance of 18 inches between the outside of the water main and outside of the sewer. This shall be the case where the water main is either above or below the sewer with preference to the water main located above the sewer.

At crossings, one full length of water pipe shall be located midpoint so both joints will be as far from the sewer as practically possible. Special structural support for the water and sewer pipes may be required.

6.1.8 Exceptions

When it is impossible to obtain the minimum specified horizontal and vertical isolation, the reviewing authority may approve a variance from the requirements of Sections 6.1.6 and 6.1.7. Where gravity sewers are being installed and these requirements cannot be met, the water main may be installed closer to a gravity sewer, provided that the water main is laid in a separate trench. The following factors should be considered in determining adequate separation:

1. Materials and type of joints for water and sewer pipes;
2. Soil conditions;
3. Service and branch connections into the water main and sewer line;
4. Compensating variations in the horizontal and vertical separations
5. Space for repair and alterations of water and sewer pipes; and
6. Off-setting of pipes around manholes.

6.1.9 Force Mains

In all cases, there shall be at least a 10 foot horizontal separation between water mains and sanitary sewer force mains. There shall be at least an 18 inch vertical separation at crossings.

6.1.10 Testing

The installed pipe shall be pressure tested and leakage tested in accordance with the appropriate AWWA Standard (C-600 or C-605).

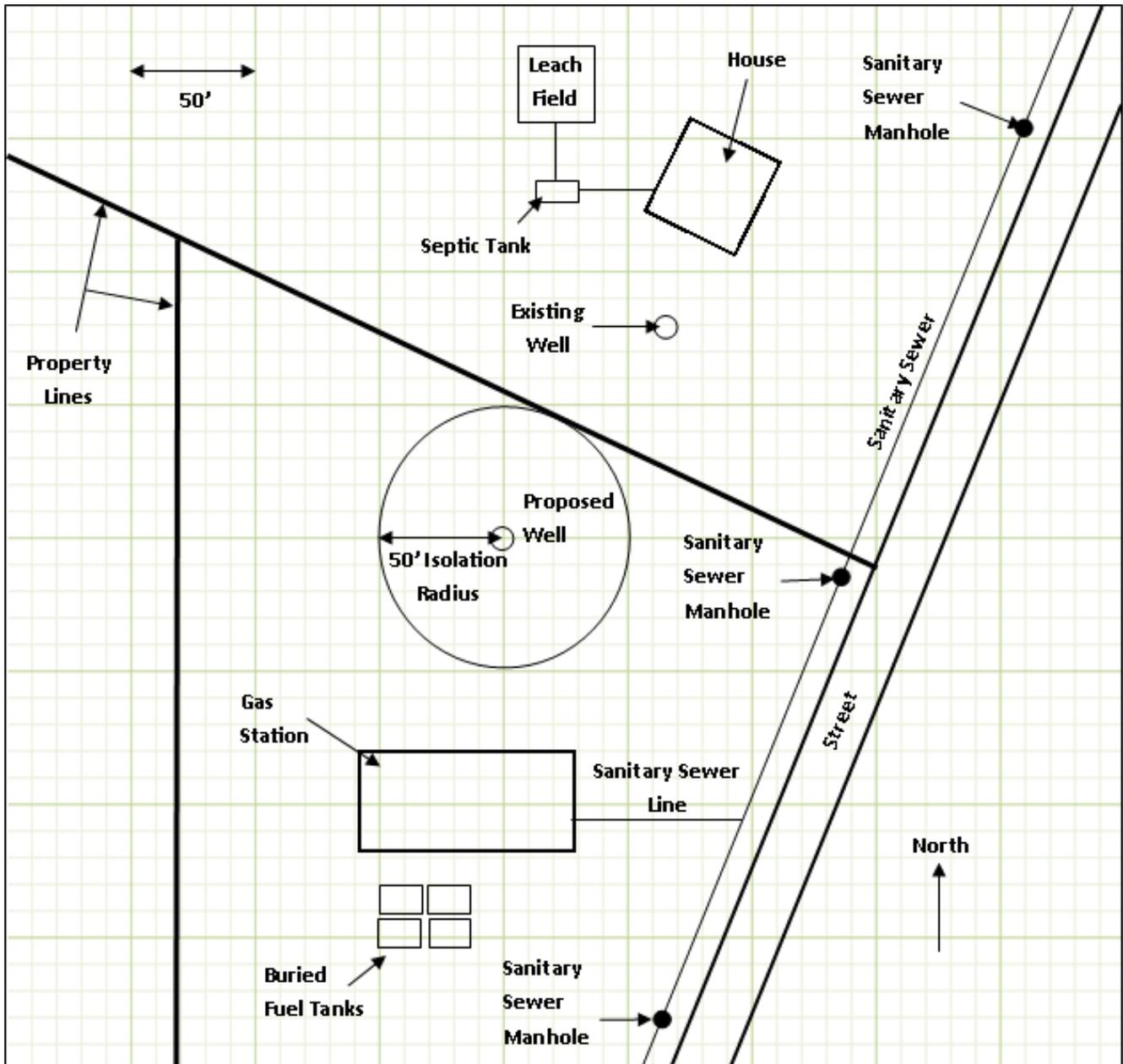
6.1.11 Disinfection

All new distribution systems shall be disinfected in accordance with AWWA C-651.

6.2 Backflow Prevention and Cross-Connection Control

- 6.2.1 The connection of service lines to the distribution system shall be in accordance with applicable provisions of OAC Chapter 3745-95 (Backflow Prevention and Cross-Connection Control).
- 6.2.2 Booster pumps shall not be approved on individual service connections to one, two or three family dwellings unless an air gap separation is provided.
- 6.2.3 Private wells should be properly sealed as a condition of providing service to any customer. Where private wells are allowed to remain in service, they must be physically separated from the plumbing system and approved reduced pressure principle backflow prevention devices must be installed on the service connections, unless otherwise controlled according to the provisions of OAC Rule 3745-95-04. In accordance with OAC Rule 3745-95-04, an example of educational material can be found on Ohio EPA's website. .
- 6.2.4 There shall be no connection between the distribution system and any pipes, pumps, hydrants or tanks whereby unsafe water or other contaminating materials may be discharged or drawn into the distribution system.
- 6.2.5 Auxiliary water systems are prohibited from being interconnected to public water supply systems unless appropriate backflow prevention devices are used and plan approval is obtained from Ohio EPA's Division of Drinking and Ground Waters. More detailed information is provided in Ohio EPA's "Backflow Prevention and Cross-Connection Control Manual" and in OAC Chapter 3745-95.

APPENDIX A - Example Well Site Map



APPENDIX B - Suggested Water Usage Guide

Facility Type	Gallons per Day
Camps/Parks/Recreation/Travel	
Airports (per passenger)	5
Beaches (per swimmer)	10
Bowling Alleys (per lane)	75
Camp Providing Central Bath & Toilet Facilities (per person)	35
Country Clubs (per member)	50
Golf Course (per person)	5
Highway Rest Area (per person)	5
Overnight with Flush Toilets, no shower (per person)	25
Picnic Areas with Flush Toilets (per person)	10
Picnic Areas with Bathhouses, Showers and Toilets (per person)	20
Primitive Camp (per person)	5
Recreational Vehicle/Travel with Centralized Comfort Station without Water & Sewer (per space)	75
Recreational Vehicle/Travel with Water & Sewer (per space)	125
Swimming Pools (per swimmer)	5
Youth and Recreational Camps (per person)	50
Employment Facilities	
Factories, no showers (per person)	25
Factories with showers (per person)	35
Office Buildings (per person)	20
Retail Stores (per employee)	20
Hotels/Motels	
Boardinghouse/Bed & Breakfast (per boarder)	50
Hotels/Motels (per room)	60
Hotels/Motels with Kitchen (per room)	100
Resort Hotels and Motels (per person)	100
Institutions	
Assisted Living (per person)	125
Hospitals (per bed)	300
Nursing Homes (per bed)	150
Nursing Homes (per resident employee)	100
Nursing Homes (per non-resident employee)	50
Residential/Correctional Facilities (per person)	100
Miscellaneous	
Assembly/Dance Halls (per person)	2
Churches (per seat)	5
Churches with Kitchen (per seat)	7
Laundries, Self-Service (per machine)	400
Service stations (per 1 st bay or pump island)	1,000
Service Stations (additional bay or pump island)	500
Residential Communities	
Apartment, One Bedroom	250
Apartment, Two Bedrooms	300
Apartment, Three Bedrooms	350
Cottages, Seasonal Occupancy (per resident)	50
Migrant Labor (per person)	50
Mobile Homes (per unit)	300
Multiple Family (per bedroom)	120
Single Family (per house)	400
Per Capita	100

Facility Type	Gallons per Day
Restaurants	
Banquet Rooms (per seat)	5
Fast Food (per customer)	2
Ordinary Restaurants, not 24-Hour (per seat)	35
Restaurant/Truck Stop along Freeway (per seat)	100
24-Hour Restaurant (per seat)	50
Schools	
Boarding (per person)	10
Elementary/Day Care (per person)	15
High & Jr. High (per person)	20
Theaters	
Drive-In (per car space)	5
Movie (per seat)	3

APPENDIX C - Sample ODNR Well Log and Drilling Report

SAMPLE ODNR WELL LOG AND DRILLING REPORT

WELL LOCATION		CONSTRUCTION DETAILS																												
DNR 7802.06 TYPE OR USE PEN SELF TRANSCRIBING PRESS HARD		WELL LOG AND DRILLING REPORT Ohio Department of Natural Resources Division of Water, 1939 Fountain Square Drive Columbus, Ohio 43224-9971 Voice (614) 265-6739 Fax (614) 447-9503																												
County <u>Delaware</u> Township <u>Trenton</u>		<input checked="" type="checkbox"/> Rotary <input type="checkbox"/> Cable <input type="checkbox"/> Augered <input type="checkbox"/> Driven <input type="checkbox"/> Other _____ BOREHOLE/CASING (measured from ground surface)																												
Owner/Builder <u>E. J. Fudd</u> (Use One or Both) First Last		1 <input checked="" type="checkbox"/> Borehole Diameter <u>7 7/8</u> inches Depth <u>127</u> ft. Casing Diameter <u>5</u> in. Length <u>20</u> ft. Thickness <u>.327</u> in.																												
Address of Well Location <u>181 Green Cook Rd.</u> Number Street Name		2 <input type="checkbox"/> Borehole Diameter _____ inches Depth _____ ft. Casing Diameter <u>5</u> in. Length <u>102</u> ft. Thickness <u>.265</u> in. Casing Height Above Ground <u>1</u> ft.																												
City <u>Sunbury</u> Zip Code <u>43074-9761</u>		Type 1 <input type="checkbox"/> Steel 1 <input type="checkbox"/> Galv. 1 <input checked="" type="checkbox"/> PVC 1 <input type="checkbox"/> 2 <input type="checkbox"/> Steel 2 <input type="checkbox"/> Galv. 2 <input type="checkbox"/> Other _____																												
Permit No. <u>960.95</u> Section <u>20</u> (Use One or Both)		Joints 1 <input type="checkbox"/> Threaded 1 <input checked="" type="checkbox"/> Solvent 1 <input type="checkbox"/> 2 <input type="checkbox"/> Threaded 2 <input type="checkbox"/> Welded 2 <input checked="" type="checkbox"/> Other _____																												
Location of Well in State Plane coordinates, if available: Use of Well <u>Residential</u>		SCREEN Diameter <u>5 in</u> Slot Size <u>.050 in</u> Screen Length <u>5</u> ft. Type <u>Machine-slotted</u> Material <u>PVC</u> Set Between <u>122</u> ft. and <u>127</u> ft.																												
N <input checked="" type="checkbox"/> X <u>195339</u> .425 +/- <u>20</u> ft or m S <input type="checkbox"/> Y <u>1922944</u> .533 +/- <u>20</u> ft or m Elevation of Well <u>1084</u> +/- <u>5</u> ft or m		Datum Plain: <input checked="" type="checkbox"/> NAD27 <input type="checkbox"/> NAD83 Elevation Source <u>Topo map</u> Source of Coordinates: <input checked="" type="checkbox"/> GPS <input type="checkbox"/> Survey <input type="checkbox"/> Other _____																												
Sketch a map showing distance well lies from numbered state highways, street intersections, county roads, buildings or other notable landmarks. If latitude and longitude are available please include here: Lat: <u>40°12'09"</u> Long: <u>82°46'35"</u> North		GRAVEL PACK (Filter Pack) Material/Size <u>#4 Parry sand</u> Volume/Weight Used <u>400 lbs</u> Method of Installation <u>Gravity pour</u> Depth: Placed FROM <u>118</u> ft. TO <u>127</u> ft.																												
		GROUT Material <u>Benseal/EZ Mud</u> Volume/Weight Used <u>175 gal</u> Method of Installation <u>Pumped through 1" tremie tube</u> Depth: Placed FROM <u>118</u> ft. TO <u>surface</u> ft.																												
		DRILLING LOG* INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED. Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand, etc.																												
WELL TEST* Pre-Pumping Static Level <u>20</u> ft. Date <u>12/10/95</u> Measured from: <input checked="" type="checkbox"/> Top of Casing <input type="checkbox"/> Ground Level <input type="checkbox"/> Other _____ <input checked="" type="checkbox"/> Air <input type="checkbox"/> Bailing <input type="checkbox"/> Pumping* <input type="checkbox"/> Other _____ Test Rate <u>35</u> gpm Duration of Test <u>1</u> hrs. Feet of Drawdown <u>20</u> ft. Sustainable Yield <u>25</u> gpm *(Attach a copy of the pumping test record, per section 1521.05, ORC) Is Copy Attached? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Flowing Well? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Quality <u>Clear, 1ppm Fe, 30 gpg hardness, pH 7</u>		<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 80%;"></th> <th style="width: 10%;">From</th> <th style="width: 10%;">To</th> </tr> </thead> <tbody> <tr> <td>Brown clay</td> <td>0</td> <td>15</td> </tr> <tr> <td>Gray sandy clay</td> <td>15</td> <td>20</td> </tr> <tr> <td>Sand & gravel (dry)</td> <td>20</td> <td>22</td> </tr> <tr> <td>Gray clay w/gravel</td> <td>22</td> <td>33</td> </tr> <tr> <td>Sand & gravel (dry)</td> <td>33</td> <td>39</td> </tr> <tr> <td>Gray clay</td> <td>39</td> <td>119</td> </tr> <tr> <td>Coarse sand & gravel</td> <td>119</td> <td>127</td> </tr> <tr> <td>Water encountered at 122'</td> <td></td> <td></td> </tr> </tbody> </table>			From	To	Brown clay	0	15	Gray sandy clay	15	20	Sand & gravel (dry)	20	22	Gray clay w/gravel	22	33	Sand & gravel (dry)	33	39	Gray clay	39	119	Coarse sand & gravel	119	127	Water encountered at 122'		
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PUMP/PITLESS Type of pump <u>Submersible</u> Capacity <u>10</u> gpm Pump set at <u>65</u> ft. Pitless Type <u>Adapter</u> Pump installed by <u>Acme Drilling Co.</u> I hereby certify the information given is accurate and correct to the best of my knowledge. Drilling Firm <u>Acme Drilling Co.</u> Address <u>1234 Main St.</u> City, State, Zip <u>Anytown, Ohio 56789</u>		Signed <u>W.E. Coyote</u> Date <u>1/23/96</u> ODH Registration Number <u>1111</u> Date of Well Completion <u>12/10/95</u> Total Depth of Well <u>127</u> ft.																												
Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling. ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224-9971 Blue - Customer's copy Pink - Driller's copy Green - Local Health Dept. copy																														

APPENDIX D - Well Construction Worksheet for Existing Wells



Well Construction Worksheet for Existing Wells

The Ohio Administrative Code (OAC) establishes standards for public water system well construction. If the well log is not available, have this worksheet completed by a state-registered driller and returned to the appropriate district office.

Inspected For						
Water System Name:						
Address:						
City:		Zip:	-	County:		
PWS-ID:		Well Number:				
Location Description:						
Contact Person:		Phone:		Fax:		
Construction Details						
Casing Diameter:		Inches	Latitude:			
Casing Length:*		Feet	Latitude:			
Determined by:	<input type="checkbox"/> Casing Depth Indicator <input type="checkbox"/> Down-Hole Camera					
Depth to Bedrock:		Feet	Elevation:			
*Casing length cannot be estimated.						
Observable Deficiencies						
Excessive Corrosion or Pin-holing of the Casing	<input type="checkbox"/>	Yes	<input type="checkbox"/>	No	<input type="checkbox"/>	CND*
Pitless Unit Secure	<input type="checkbox"/>	Yes	<input type="checkbox"/>	No	<input type="checkbox"/>	CND*
Bent or Dented Casing Below Ground	<input type="checkbox"/>	Yes	<input type="checkbox"/>	No	<input type="checkbox"/>	CND*
Well Grouted	<input type="checkbox"/>	Yes	<input type="checkbox"/>	No	<input type="checkbox"/>	CND*
*Could not be determined						
Inspector Information						
Inspected by (drilling firm):						
Inspector Name:						
Address:						
City:		State:		Zip:	-	
Date of Inspection:	/	/	Phone:		Fax:	

APPENDIX E - 24-Hour Pumping Test Report



24-Hour Pumping Test Report

Name of Entity:			
County:			PWS-ID:
Well Number:			ODNR Well Log #:
Name of Person Preparing Report:			
Well Location:			
Construction Details			
Latitude:	West	Longitude:	North
Pump Setting Depth:	Feet		
Static Level (So):	Feet		
The distance from the ground to the surface of the water column in the well measured after at least 12 hours without pumping to ensure a constant static level.			
Discharge Rage:	Gallons per Minute		
The test is to be run at the peak hourly demand or at least 1.5 times the design pumping rate if the well cannot sustain peak hourly flow.			
<p>Method for Measuring Flow Rate: Please explain how the discharge rate was measured during the pumping test. Ohio Administrative Code Rule 3745-9-09 (B)(5) specifies the flow rate shall be measured by using an orifice weir with manometer or by using another method acceptable to the director.</p>			
Duration of Pumping:			
Pumping shall continue for at least 24 hours, unless the daily usage is less than 10,000 gallons (low usage). For low usage facilities, the pump test must be as long as the normal operating hours of the proposed entity.			
<p>RECOVERY LEVELS AT VARIOUS TIME INTERVALS (ATTACH) The distance from the ground to the water surface in the well after pumping has ceased. Levels should be recorded every 5 minutes for the first hour and every ½ hour thereafter until essentially there is no change in the water level.</p>			



Pumping Test

Date (start of pump test):	/	/
----------------------------	---	---

Time (Military)	Time since pumping started (minute)	Depth to Water (S)	Change in Water Level (S-So)	Discharge Rate (GPM)	Comments (Include Weather Conditions)
	0				
	1				
	2				
	3				
	4				
	5				
	6				
	7				
	8				
	9				
	10				
	11				
	12				
	13				
	14				
	15				
	20				
	25				

Time (Military)	Time since pumping started (minute)	Depth to Water (S)	Change in Water Level (S-So)	Discharge Rate (GPM)	Comments (Include Weather Conditions)
	30				
	35				
	40				
	45				
	50				
	55				
	60 (1hr)				
	70				
	80				
	90				
	100				
	110				
	120 (2hr)				
	140				
	160				
	180 (3hr)				
	210				
	240 (4hr)				
	270				
	300 (5hr)				
	360 (6hr)				
	420 (7hr)				
	480 (8hr)				
	540 (9hr)				
	600 (10hr)				

Time (Military)	Time since pumping started (minute)	Depth to Water (S)	Change in Water Level (S-So)	Discharge Rate (GPM)	Comments (Include Weather Conditions)
	660 (11hr)				
	720 (12hr)				
	780 (13hr)				
	840 (14hr)				
	900 (15hr)				
	960 (16hr)				
	1020 (17hr)				
	1080 (18hr)				
	1140 (19hr)				
	1200 (20hr)				
	1260 (21hr)				
	1320 (22hr)				
	1380 (23hr)				
	1440 (24hr)				

Date (end of pump test):	/	/
Specific capacity of well at the tested pumping rate(s):		<i>Specific Capacity = Pumping rate/change in water level</i>

Recovery

Time (Military)	Time since pumping started (minute)	Depth to Water (S)	Change in Water Level (S-So)	Discharge Rate (GPM)	Comments (Include Weather Conditions)
	0				
	5				
	10				
	15				
	20				
	25				
	30				
	35				
	40				
	45				
	50				
	55				
	60 (1hr)				
	90				
	120 (2hr)				
	150				
	180 (3hr)				
	210				
	240 (4hr)				
	270				
	300 (5hr)				

APPENDIX F - Sample ODNR Water Well Sealing Report

EXAMPLE OF ODNR WATER WELL SEALING REPORT

DNR 7610.96

WATER WELL SEALING REPORT
OHIO DEPARTMENT OF NATURAL RESOURCES
 Division of Water
 1939 Fountain Square Drive
 Columbus, Ohio 43224-9971
 Voice: (614) 265-6739 Fax: (614) 447-9503

LOCATION

County Delaware Township Trenton Circle One or Both Section Lot Number 20
 Owner/Bulfer E. J. Fudd
Circle One or Both
 Address of Well Location 181 Green Cook Rd.
Number Street Name
 City Granberry Zip Code +4 43074-9761
.2 miles South of St. Rt. 37
R. E. S. W. Street Intersection
 Property Location Description on the East side of Green Cook Rd.
N, S, E, W Road Name
 Location of Well in State Plane N X 195339.43 + 20 Y 1922944.53 + 20
Coordinates if available Datum
 Elevation of Well 1084.1 + 5 Datum Plain: NAD27 NAD83
 Source of Coordinates: GPS Survey Other

ORIGINAL WELL ODNR Well Log Number N/A Copy attached? Yes No (circle one)

MEASURED CONSTRUCTION DETAILS Date of measurements 12/22/95
 Depth of Well 127 ft. Static Water Level 20 ft.
 Size of Casing 5 in. Length of casing 127 ft.
 Well Condition Good

SEALING PROCEDURE

Method of Placement PRESSURE GROUT - Pumped through 1" tremie tube.

	Sealing Material	Volume
Placement: From <u>127</u> To <u>surface</u>	<u>Benesol/EZ Mud Slurry</u>	<u>130 gallons</u>
From _____ To _____	_____	_____
From _____ To _____	_____	_____

 Was Casing Removed? Yes No (circle one)
 Condition of Casing GOOD
 Perforations: From _____ To _____
 From _____ To _____
 Date Sealing Performed 12/22/95
 Reason(s) for Sealing WELL NO LONGER NEEDED.

CONTRACTOR

Name ACMR DRILLING COMPANY ODNR Registration # 1111
 Address 1234 MAIN ST.
 City/State/Zip Anytown, OH, 55789
 Signature W.B. Capote
I hereby certify the information given is accurate and correct to the best of my knowledge.

Completion of this form is required by section 1521.05 (B) (5), Ohio Revised Code - file within 30 days after completion of sealing.
ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224
Blue - Customer's copy Pink - Driller's copy Green - Local Health Dept. copy

APPENDIX G - Hauled Water System – Design Requirements

Hauled Water System - Design Requirements

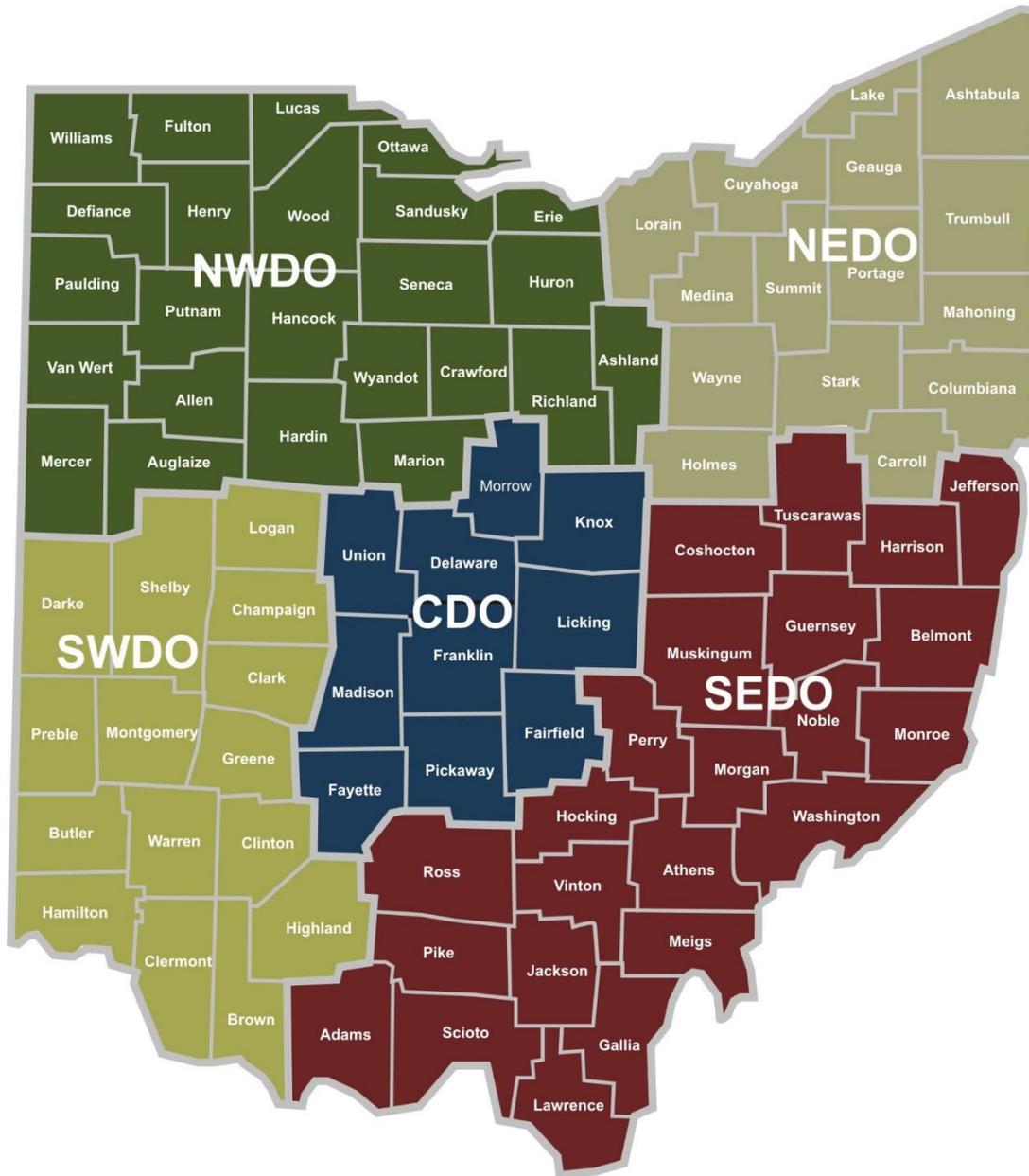
Public water systems using hauled water are exempt from Section 6109.02 of the Ohio Revised Code if all of the following conditions are met:

1. Consists only of distribution and storage facilities and does not have any collection and treatment facilities.
2. Obtains all of its water from, but is not owned or operated by, a public water system.
3. Does not sell water to any person.
4. Is not a carrier which conveys passengers in interstate commerce.

If the proposed hauled water system will qualify for the exempt status, then the District Office should be notified accordingly. If it will not qualify as an exempt system, then detail plans must be submitted and approved prior to construction of the hauled water system. Hauled water systems should only be considered for noncommunity public water systems. General design criteria and the type of information to be presented on the detail plans are as follows:

1. Name of the project
2. Owner's name and address
3. Vicinity map showing project location
4. Name of person/firm preparing the plan
5. A site plan, drawn to scale, showing existing and/or proposed:
 - a) Property lines
 - b) Outline of buildings, including those relevant to the project which are located on adjacent properties
 - c) Water system location
 - d) Sewerage system location
 - e) North arrow to show orientation
 - f) Underground utilities which are possible sources of contamination to a buried bulk water tank (storm sewer, sanitary sewer, oil/gas lines, etc.)
6. Design parameters
7. Tank:
 1. Tank should be sized to provide 3 to 5 days storage; however, the tank should not be less than either 2,500 gallons or the size of the water hauler's tank. Under special conditions or extremely low flows, tanks smaller than 2,500 gallons can be considered. Supplemental chlorination may be necessary if the tank will sized for more than 5 days of storage. A very large hauled water system shall be constructed with multiple tanks that can be independently isolated and de-watered to facilitate cleaning and maintenance.
 2. Tank materials include: concrete, fiberglass, plastic and steel. Steel tanks should not be buried. Buried fiberglass or plastic tanks must be secured to a concrete pad to address flotation concerns. If in an area of VOC contamination, fiberglass and plastic tanks are not permitted below grade.
 3. Means to evaluate water level
 4. Low level alarm
 5. 24 inch diameter access manhole

6. Sanitary fill
 7. Overflow
 8. Vent
 9. Security
 10. Drain
 11. Final grading provides positive drainage away from tank
8. Discharge pump/pressure tank:
 1. Discharge pump capacity \geq peak hourly demand
 2. Discharge pump centerline to be below lowest water level
 3. Pressure tank(s) drawdown must satisfy pump manufacturer's minimum run time
9. Miscellaneous:
 1. Sample tap(s)
 2. Associated piping approved for potable water
 3. Identification of water hauler (must be registered with the local health department)
 4. Identification of water source(s) (must be from an approved municipal supply)



Central Office

Lazarus Government Center
 50 W. Town St., Suite 700
 Columbus, OH 43215
 (614) 644-3020

Central District Office

Lazarus Government Center
 50 W. Town St., Suite 700
 Columbus, OH 43215
 (614) 728-3778
 (800) 686-2330

Northwest District Office

347 N. Dunbridge Rd.
 Bowling Green, OH 43402
 (419) 352-8461
 (800) 686-6930

Southeast District Office

2195 E. Front Street
 Logan, OH 43138
 (740) 385-8501
 (800) 686-7330

Northeast District Office

2110 E. Aurora Rd.
 Twinsburg, OH 44087
 (330) 963-1200
 (800) 686-6330

Southwest District Office

401 E. Fifth St.
 Dayton, OH 45402
 (937) 285-6357
 (800) 686-8930

*Toll-free numbers are for citizens with questions or concerns about environmental issues.
 The regulated community should use the business line for routine business.
 Spills and emergencies should be reported to (800) 282-9378.*