Ohio Environmental Protection Agency

Guidelines for Design of Small Public Ground Water Systems

Division of Drinking and Ground Waters

~~2014~~2015

Ohio Environmental Protection Agency
Division of Drinking and Ground Waters
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FOREWORD

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 using only ground water. The objective here is to assure that new or substantially modified public water system facilities, such as those for 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 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.

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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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 INFRASTUCTURE 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:

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 good lighting around wells, pumphouses, treatment facilities and parking areas; and,

D. Locking monitoring wells, securing vents by moving them inside or providing vandal resistant screens and fencing.

STATEMENT ON ALTERNATIVE WATER TREAMENT 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 ~~has developed an Emerging Technologies Guidance document~~ 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.

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.

High-rated ground water treatment plants 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.

Chapter 1

DEFINITIONS

1.1 Public Water System (PWS)

A public water system provides ~~piped~~ 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, as defined in OAC Rule 3745-81-01; or is any water supply system serving an agricultural migrant labor camp as defined in Section 3733.41 of the Ohio Revised Code (ORC).

1.2 Types of Public Water Systems

A. 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.

B. 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.

C. 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.

D. Agricultural Migrant Labor Camp:

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

E. Exempt Water System:

A water system that is exempt from Ohio EPA Drinking Water Regulations (ORC Section 6109.02). In order to be exempt, all of the following conditions must be 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, e.g., airline, railroad, bus line, boat line, etc.

Chapter 2

PROCEDURE FOR ESTABLISHING A SMALL PUBLIC GROUND WATER SYSTEM

2.1 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. As a last resort, a hauled water system may be considered, (see Section 2.5). The owner must be aware that hauled water systems are more susceptible to interruption of supply and may be more susceptible to contamination.

2.2 Plan Submittal Requirements

According to Section 6109.07 of the Ohio Revised Code:

A. No person shall begin construction or installation of a public water system, or make a substantial change in a public water system, until plans therefor 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 Chapter 6109 of the Ohio Revised Code and rules adopted under it.

B. No person shall construct or install a public water system, or make any substantial change in a public water system, which is not in accordance with plans approved by the Director.

According to Rule 3745-91-01(C) of the Ohio Administrative Code:

“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.

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.

2.3 Connection to an Existing Approved System

A. Contact existing public water system(s) within an economical piping distance.

B. Determine what needs to be done to facilitate the connection to the existing system.

~~**B.**~~**C.** ~~If arrangements can be made to connect to an existing system, have a professional engineer or water supply specialist knowledgeable in system design prepare plans for the connection and distribution system. The plans must be acceptable to the water system from which the water is to be obtained. Plans~~ 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.

2.4 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.

A. 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.)

B. Submit a completed well site application to the District Office (see Appendix B).

C. Obtain a well site inspection and site acceptance from the District Office.

D. Arrange with an Ohio EPA certified laboratory for analysis of the required parameters for new wells after the well has been drilled and developed. Allow at least six weeks for analysis of samples. A list of required parameters (Parameters Required for Complete Well Analysis) is included in Appendix F and is current as of the date of this publication. ~~and A copy of this list~~ This list is also available in the Appendix to OAC Rule 3745-9-09.

E. The well must be constructed and grouted in accordance with the construction and grouting standards prescribed in Ohio Administrative Code (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 3.6, with requirements specific to PVC casing noted in item 3.6C.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.

F. Perform a pumping test (refer to Section 3.8) and collect the required samples at the conclusion.

G. Submit the pumping test and sample analyses to the District Office for evaluation and information regarding the treatment processes required for your proposed system based on the sample analyses.

H. Have a professional engineer or a water supply specialist knowledgeable in design prepare plans for the system, covering well construction, treatment, storage and distribution.

I. Submit detail plans to the District Office. Construction of the treatment, storage and distribution system must not begin until the formal approval letter is received from the Director of Ohio EPA.

2.5 Develop an Approved Storage System Using Hauled Water

Where the above systems cannot be developed, use of a storage tank with hauled water may be considered.

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 1.2E). If the hauled water system is not exempt, plans will be required (see Appendix J). If the hauled water system will be exempt, the required health department and plumbing permits must still be obtained.

2.6 Plan Submittal and Information Required on Plans

Detail plans are required for a proposed water system. These should be prepared by a professional engineer (see Appendix K, or in accordance with ORC Section 4733.17) or a water supply specialist knowledgeable in system design. Three sets of plans should be submitted at least 60 days prior to the desired approval date. These plans shall contain the following, where applicable:

A. A site map (Appendix C), drawn to scale, showing existing and/or proposed:

1. Property lines, ownership of land, and land use of surrounding properties.

2. Outlines of buildings, including those relevant to the project which are located on adjacent properties.

3. Water system location.

4. Sewerage system location.

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.

6. Nearby streets, driveways, and enough boundary information to locate the project.

7. Ultimate expansion of the project.

8. North arrow to show orientation.

9. Elevations pertinent to the design.

10. Location of water mains, pump stations, raw water intakes, water plant, waste disposal facilities, and other existing or proposed parts of this system.

11. Locations of potential contaminant sources within drinking water source protection area, both the inner management zone and five year time of travel area.

B. Details showing conformance with standards and requirements for:

1. Source (Chapter 3)

2. Treatment (Chapter 4)

3. Storage (Chapter 5)

4. Distribution (Chapter 6)

C. A Water Supply Data Sheet is provided in Appendix A and should be copied from this publication when needed. The most current edition of the Water Supply Data Sheet can also be found on the Ohio EPA website.

D. A submittal letter from the owner or the owner's representative, requesting approval of the plans.

E. One copy of the specifications and supporting data (e.g., well log, pumping test, etc.)

F. Plan review fee (payable to the Treasurer, State of Ohio) of $150.00 plus 0.35 percent (0.0035) of the estimated construction cost of the water system or system improvements shown on the Water Supply Data Sheet (Appendix A), or most current fee. The most current edition of the Water Supply Data Sheet and method of fee calculation can also be found on the Ohio EPA website. If the project includes the drilling, boring, digging, deepening, altering and/or logging of a well for the purpose of extracting potable water as part of a public water system required to be licensed under Chapter 6109 of the Revised Code, include a $20.00 well log filing fee per well log, in the review fee calculation. Ohio EPA is required to collect this fee for ODNR.

G. Other letters as appropriate:

1. PUCO certificate of convenience and necessity, if applicable.

2. Certification of escrow deposit (see OAC Rule 3745-92), if applicable.

H. A title page showing, at a minimum:

1. The owner's name and address.

2. The official name and address of the public water system.

3. The title of the project being submitted for review.

4. The public water system identification number (PWSID).

5. PE stamp (as required by ORC Section 4733.17, or see Appendix K).

6. Signature of water system owner approving the plans.

I. A capability assurance plan (CAP) is required for all new community and nontransient noncommunity public water systems. The CAP must include a general plan, a management plan, and a financial plan as defined in OAC Rule 3745-87-02. A CAP is also required by any system receiving State Revolving Loan Funding.

Chapter 3

SOURCE

3.1 General

When it is necessary to develop a well supply, the engineer or the water supply specialist must demonstrate to the satisfaction of Ohio EPA that an adequate quantity of water will be available, and that the water which is to be delivered to the consumers will meet the requirements of Ohio EPA with respect to microbiological, chemical and radiological qualities. Approval of the source will be contingent on the quality and quantity of the source.

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

3.2 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).

3.3 Quality of Water

A. 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, noted on the sample submission form, and found to be undetectable prior to sampling. Two safe (total coliform negative) microbiological samples taken at least 30 minutes ~~24 hours~~ apart shall be taken from the well. Analysis shall be made in an Ohio EPA certified laboratory. 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.

B. 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.

The samples for laboratory examination must be collected at the conclusion of the pumping test procedures. Quality involves microbiological, chemical and radiological considerations. Ohio EPA will 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 Chapter 4). Test wells exceeding primary (health based) contaminant levels, if granted a variance, may require treatment beyond the scope of this manual.

C. Secondary Standards

The presence of secondary and other aesthetic contaminants above the secondary limits may require treatment.

Treatment may be required for 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. ~~Special conditions regarding public notification on the source's high sodium levels may be required as a component of plan approval.~~ Community PWSs having sources with high levels of sodium are strongly encouraged to ensure that the susceptible population is informed and educated.

3.4 Well Site Acceptance

A. Requirements

Sites for new public water supply wells must be accepted by Ohio EPA before the wells are drilled. Contact the District Office for more information.

B. Submittals

Submit a completed well site application to the District Office (see Appendix B).

NOTE: *Refer to Appendix D 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 3.5A.*

C. 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 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 3.4E).

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.

D. Site Evaluation

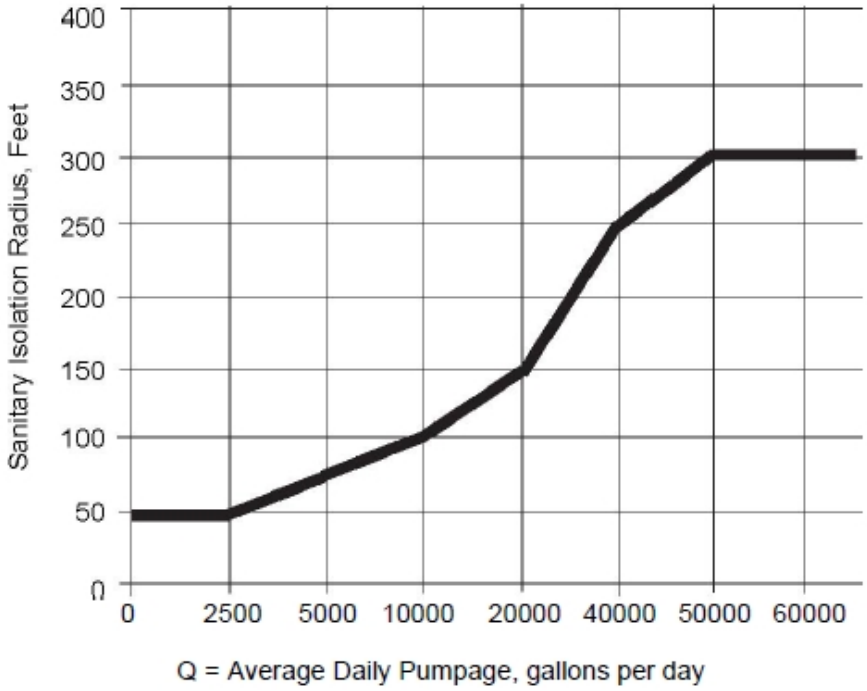
The owner will receive a letter either accepting or rejecting the site for the proposed project. Additional requirements may be stipulated in the well site acceptance letter.

E. 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, acceptance 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 2,501-10,000 gpd 10,001-50,000 gpd Over 50,000 gpd	50 feet (Square Root of Q) feet (50 + Q/200) feet 300 feet

FIGURE 1: WELL ISOLATION RADIUS



Use the schedule or the chart provided above 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.

~~In no case shall a source of possible contamination be closer than 50 feet to a well.~~ Where geological factors warrant less isolation from sources of contamination, a ~~professional hydrogeologist's~~ 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. Land application of sludge or manure, fertilizers, herbicides~~,~~ or pesticides shall not be applied within easements. The easement must meet specifications set forth in OAC Rule 3745-09-04 and shall be recorded with the County Recorder's Office. ~~within the isolation radius indicated above.~~ Any proposed ~~changes in land use within the isolation radius~~

~~require~~change in land use within the isolation radius requires consultation with Ohio EPA.

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

A well shall not be located either within ten feet of or within the foundation of any building, except within a pumphouse.

A public water system well shall be located at least:

1. Fifty feet from streams and lakes.
2. Three hundred feet from a human or animal waste management facility.
3. Three hundred feet from a land application area, stockpile, storage or staging area.
4. 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.
5. Three hundred feet from a soil absorption system handling more than ten thousand gallons per day.
6. One thousand feet from a landfill or monofill.
7. Five hundred feet from a construction and demolition debris facility.

A well shall not be located in a floodway without prior acceptance of the director. 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 year time-of-travel)~~:

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 Environmental Protection Agency has determined the aquifer has a high susceptibility to contamination.
3. Land application stockpile, storage or staging area where the Ohio environmental protection agency 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 are, but not limited to:

1. Grossly contaminated (chemical or bacteriological) rivers, streams or drainage ditches. Generally 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, sewage treatment plants, and the like.

4. Livestock holding areas, barnyards or feed lots for which feed is brought in from another source. Ordinary 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, abandoned wells, etc.

F. ~~Gravity~~ Sanitary Sewers in Well Field Areas

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

1. ~~Gravity s~~Sanitary and combined sewers are not acceptable in well field areas~~.~~; ~~H~~however, they may be permitted ~~only~~ under exceptional and unavoidable circumstances. Pressure sewers and manholes shall not be permitted under any circumstances. In any case, ~~gravity~~ sanitary and combined sewers 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. Manholes are not permitted within the sanitary isolation radius.

2. The Division of Drinking and Ground Waters may require quarterly or monthly bacterial monitoring of each well when sanitary sewers are located within the isolation radius.

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.

4. Where sewers are being installed, the sewer materials shall be appropriate pressure rated pipe and shall be pressure tested to ensure water tightness.

3.5 Basis of Design

A. 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 3.5C.1).

Calculate the average daily, peak daily, and peak hourly~~instantaneous~~ 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 D 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 in regards 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~~en~~ years of historical daily flow data using the highest peak day to average day ratio for the period of record.

3. **Peak ~~Instantaneous~~ 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 ~~instantaneous~~hourly demand factor must be supported by at least one year of continuous flow and pressure data).

B. Procedure

1. **Drill Well:** After the well site acceptance letter has been received (Section 3.4), the proposed well may be drilled. ~~After January 15, 2015, only~~ 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. ~~should be drilled by an Ohio Department of Health state-registered driller.~~

2. **Test Pump:** The well shall be test-pumped 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~~3.83.~~9 for ~~record~~ pumping test report requirements.

3. **Alternative:** If the well does not have sufficient capacity to meet the standards of 3.5C, outlined below, the owner shall contact the District Office for assistance.

C. Standards

1. **Dual Wells:** Dual wells capable of meeting peak demand are required for all new community water systems and ~~those~~ new noncommunity water systems with a consumption exceeding 50,000 gpd or with a population of 500 or greater. ~~Dual wells are recommended for water systems with a consumption exceeding 5,000 gpd~~. ~~Dual pumping equipment may be acceptable in lieu of dual wells where shown to provide equivalent reliability.~~ Existing community water systems with only one fully functional well will be required to have two or more wells sized in accordance with Section 3.5.C.2 when the existing well collapses 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.

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 (Section 3.5A). 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).

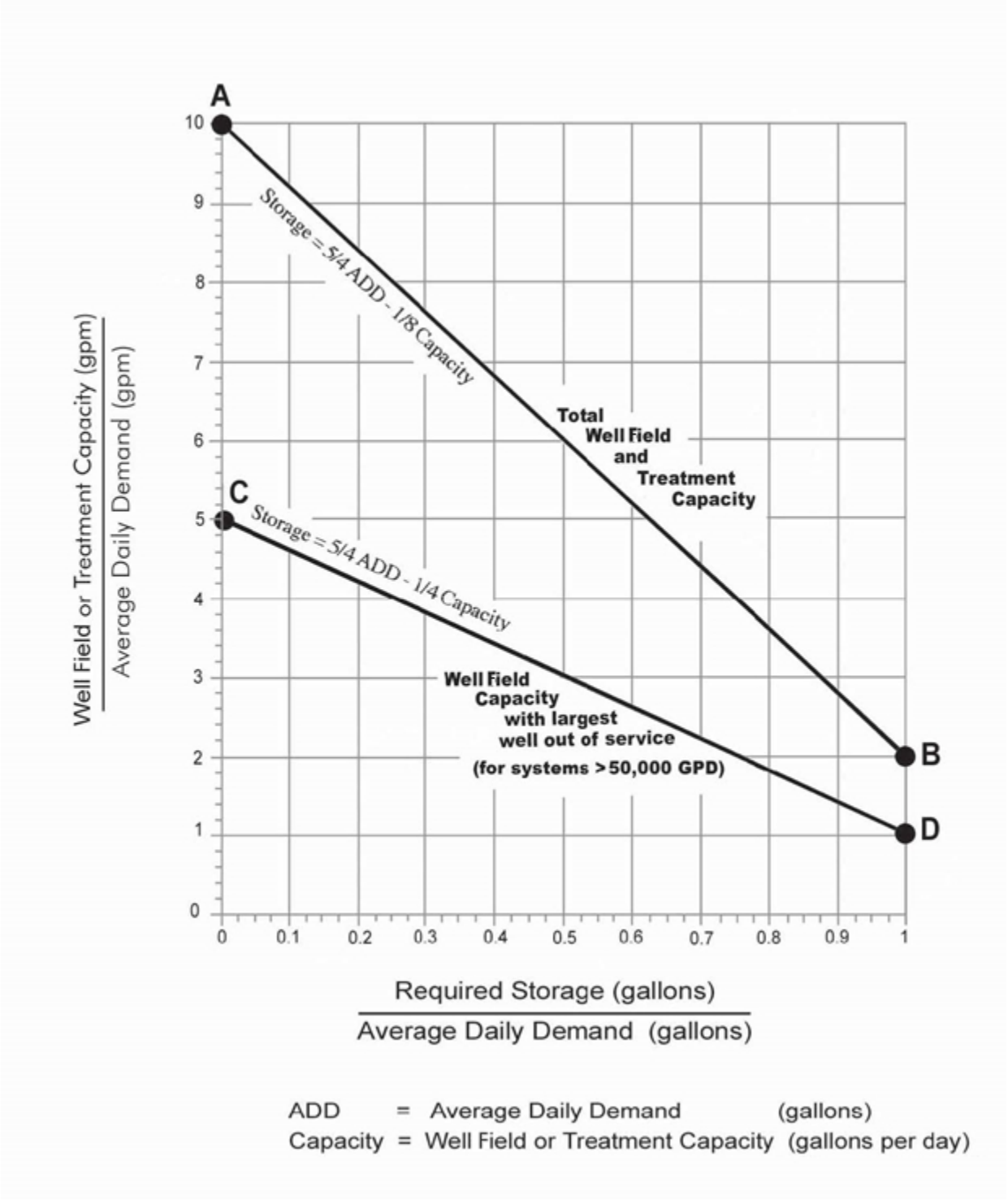
   In addition, the wells, well pumps and treatment components in a hydropneumatic pressure system using over 50,000 gpd must be sufficient to produce water at a rate that is five times the average daily water demand with the largest well or treatment

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.

~~The requirements described above are depicted on~~ Figure 2 ~~on the next page. This graph~~ can be used to determine storage requirements. A sample problem is provided following the graph. The example is solved by utilizing the graph and ~~by using the~~ storage equations. Alternative methods for estimating storage requirements may be submitted for consideration.

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

FIGURE 2: DETERMINING STORAGE REQUIREMENTS

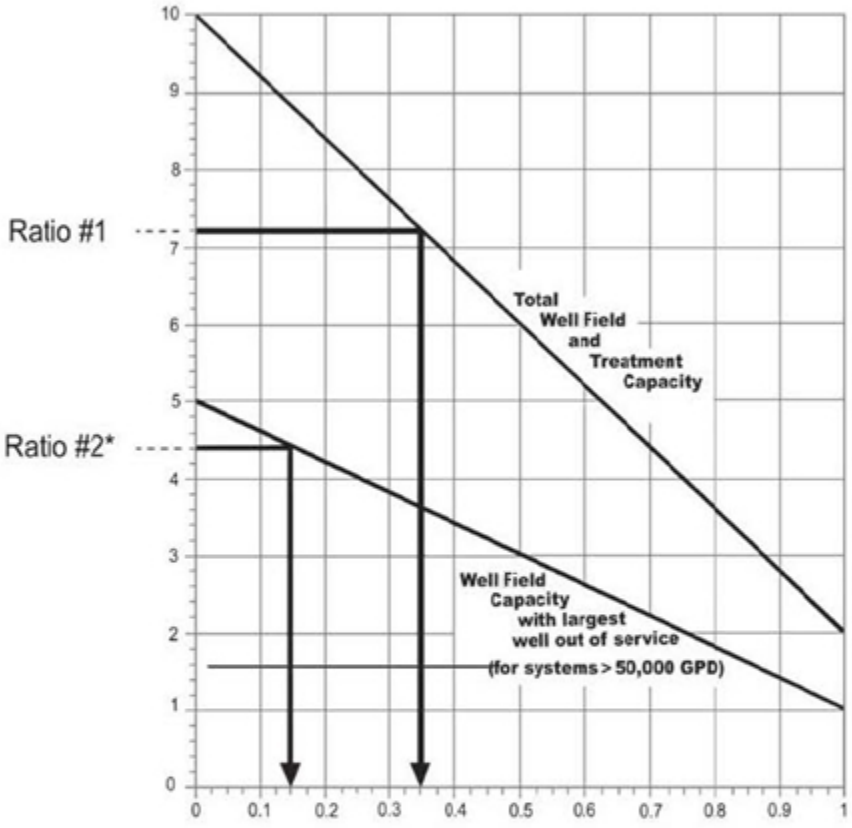


ADD = Average Daily Demand (gallons)
Capacity = Well Field or Treatment Capacity (gallons per day)

FIGURE 3: HOW TO CALCULATE 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)

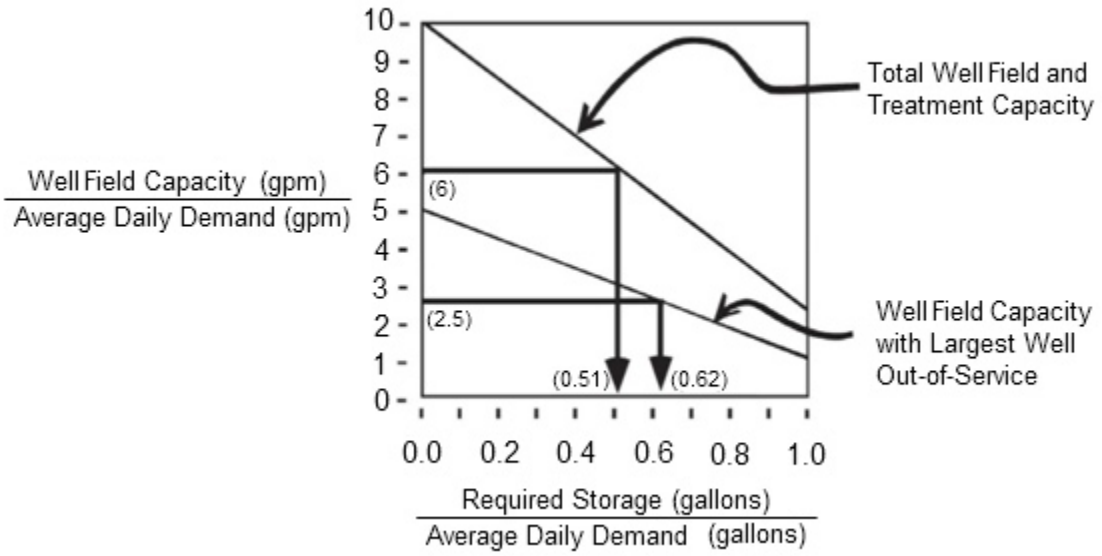
Example (solve by using the graph)

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				

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

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



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 = ~~45,000~~ 44,640 gallons

*values obtained from water usage table in Appendix D

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
Total	=	300	gpm	=	432,000	gpd				
Total	=	125	gpm	=	180,000	gpd	(without largest well)			

Total Well field and Treatment Capacity **(Equation #1)**

Storage Requirement = 5/4 x ADD – 1/8 x capacity

(5/4) (72,000) – (1/8)(432,000)

90,000 – 54,000

36,000 gallons

Well field Capacity with Largest Well Out-of-Service **(Equation #2)**

Storage Requirement = 5/4 x ADD – 1/4 x capacity

(5/4) (72,000) –

(1/4)(~~432,000~~180,000)

90,000 – 45,000

45,000 gallons

Conclusion: Storage Requirement = 45,000 gallons

*values obtained from water usage table in Appendix D

3.6 New Well Construction

A. 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).

B. Procedure

Wells shall be drilled, constructed, grouted and developed in accordance with Ohio EPA's Water Well Standards (OAC Rule 3745-9-05).

C. 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 should conform to 'Water System Council Pitless Adaptor Standard PAS-97' or with an alternative standard acceptable to the Director.
6. The well shall be provided with a downturned screened vent and a provision to measure static water level. 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.~~must provide a means to measure static water level.~~
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.~~sample of a well, or each well, to be obtained.~~
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. Yard hydrants, if used, must conform to OAC Rule 3745-95-09.

13. Well casing shall conform to the following:

a. Steel [See OAC Rule 3745-9-05].

(1). Minimum thickness.

(2). Pipe specification.

(3). Joint specifications.

b. PVC [See OAC 3745-9-05].

(1). Minimum SDR.

(2). Pipe specification.

(3). Joint specifications.

The use of PVC well casing should be discussed at the time of the well site review. Permission for the use of PVC well casing will be included in the well site acceptance letter, if deemed appropriate. The use of PVC casing is generally not granted for wells near underground fuel storage, known soil contamination or other sources of chemicals that can degrade and permeate PVC.

14. The ~~below ground water~~ service pipe installed below ground water, between the well and the treatment plant, shall be maintained under system pressure at all times. A check valve shall not be installed between the pitless device and the pressure tank.

15. The ~~below ground water~~ service pipe installed below ground water, between the well and the treatment plant or distribution system, shall be sufficiently buried to prevent it from freezing (typically 4 feet).

16. The ~~below ground water~~ service pipe installed below ground water, 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" ~~data sheet on~~ (Figure 4) ~~on Page 21~~ 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.

D. 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:

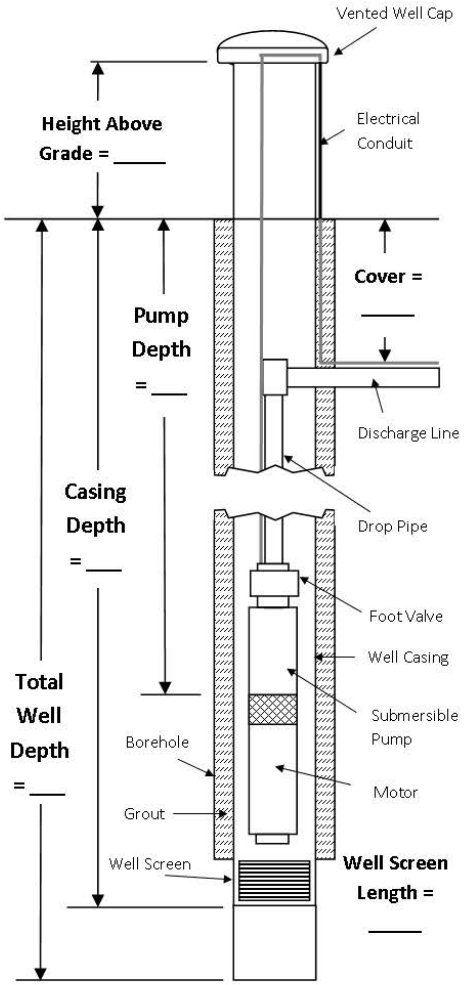
1. Conform to ANSI/AWWA Standard C219 Bolted, Sleeve-Type Couplings for Plain-End Pipe" January 23, 2011, catalog number 43219.
2. Have the same or better strength and rigidity of the well casings being joined together.

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. Use a ramped compression gasket seal that fits between the upper and lower portions of the coupling to ensure a watertight seal.
5. Ensure that a minimum of two inch length of the top and bottom casing end is contained within both the top and bottom pieces of the coupling.
6. Ensure that the coupling is centered over the joint.

FIGURE 4

WELL PROFILE AND CONSTRUCTION FORM

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



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: _____

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 _____

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.*

3.7 Approval of Existing Wells as Public Water Supply Wells

A. 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.

B. Exemptions

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

1. A complete well analysis is submitted and demonstrates acceptable water quality, or a variance is granted in accordance with rule 3745-9-02 of the Administrative Code, except ~~that a complete well analysis is not required for~~ in the following two circumstances:
   a. Community or nontransient noncommunity public water systems that have been closed for less than three years;
   b. Transient noncommunity public water systems that have been closed for less than five years.
2. A well not meeting minimum casing depth or casing height standards, with insufficient grouting, located in a pit, or with other deficiencies of well construction standards contained in Chapter 3745-9 of the Administrative Code as documented by the Director, is corrected within six months of notification by the Ohio environmental protection agency.
3. All well siting requirements are met in accordance with rule 3745-9-04 of the Administrative Code.

~~B.~~C. Procedure

Follow the same procedure as for new well acceptance. In addition, a water system contractor holding a valid registration the Ohio Department of Health ~~have a state-recognized well driller~~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 E and Appendix G) must be completed and submitted.

~~C.~~D. 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 ~~accepted~~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 Test~~ing and Record~~s

~~A. Pumping Test Report~~

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. There are three variations of the pump 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

A. 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 if the well cannot sustain peak hourly flow. For a community water system well, the ~~period of normal operation~~duration of the constant rate pumping test shall be no less than twenty-four hours;

~~1. For low use community water system wells and low or medium use noncommunity water system 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 pump design rate if the well cannot sustain peak hourly flow;~~

~~2. For medium use community water system wells, the pumping test shall be conducted at a constant rate for at least twenty-four hours either at the peak hourly demand, or at least 1.5 times the pump design rate if the well cannot sustain peak hourly flow;~~

2. For all high use wells, a 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:

   a. Consist of three or more steps of progressively increasing pumping rates.

   b. Each step shall be of approximately equal duration.

   c. Each step shall be run at a constant pumping rate for no less than forty-five minutes.

(1). 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. ~~For all high use wells, an aquifer test shall be conducted. A step-drawdown test shall be conducted with at least three progressively increasing pumping rates. Then, a constant rate pumping test shall be conducted at least twenty-four hours for at least 1.5 times the pump design rate.~~ For high use wells, all pumping tests shall include water level measurements from observation or surrounding wells. ~~Aquifer tests require measurements from an observation well.~~

B. Reduced Rate Pumping Test

For low, medium or high use wells, ~~tWhen hydrogeologic conditions or physical constraints are such that it is not possible to achieve a sustainable yield of the well at 1.5 times the pump design rate, a constant rate pumping test may be conducted at a lower pumping test rate if the following criteria are met:~~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 overly 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.
3. ~~constant rate pumping test is conducted at no less than 1.2 times the pump design rate; and~~
4. ~~A demonstration is provided documenting the hydrogeologic conditions and the lower pumping test rate.~~

Regardless of well classification, the capacity of the design pump may not exceed the pumping test rate.

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

3.9 Reporting

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

~~B.~~A. 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 by contacting ODNR, Division of Soil and Water Resources, Ground Water ~~Resources Section~~Mapping and Technical Services, at ~~www.dnr.state.oh.us/water~~http://soilandwater.ohiodnr.gov, (614) 265-67~~17~~40.

~~C.~~

~~D.~~B. Pumping Test Report

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

1. Date and times of starting through ending pumping test.
2. Pumping rate and ~~pump setting~~ depth at which the pump used for the test was set.
3. ~~Water level measurements from the well of the static water level and drawdown to the nearest 0.1 foot, as measured from an identified datum~~.A data table for each well used to observe the drawdown and recovery 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
1~~5~~6-60	5
6~~0~~1-120	10
12~~0~~1-180	20
18~~0~~1-300	30
~~300-1,440~~Greater than 300	60

4. Specific capacity of the well at the tested pumping rates.

~~5. Graphic evaluation on a semi-logarithmic graph paper by plotting the drawdown measurements on the arithmetic scale and time on the logarithmic scale;~~

5. Specific capacity of well at the anticipated permanent design pumping rate when drawdown is 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 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.
9. 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 and recovery measurements on the arithmetic scale and time on the logarithmic scale. These graphs must be submitted for the pumping well and any other wells used to observe drawdown and recovery during the step drawdown test.~~

c. Graphs plotted on semi-logarithmic graph paper showing the drawdown and 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 ~~step drawdown~~ pumping test.

d. 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.

e. Arithmetic graphs showing all water-level data collected during the pumping test and recovery period from the pumping well and all observation wells.

10. If the high use well is part of a multiple-well system the report shall also include ~~also~~ documentation demonstrating:

a. The well can supply water at the anticipated permanent design pumping rate while at minimum maintaining the operational capacity and without degrading the water quality of any well.~~The well can supply water at the anticipated permanent design pumping rate without significantly decreasing the operational capacity of the wellfield or lowering the water quality of any well, and~~

b. 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~~The operation of other wells in the water supply system or of nearby high use wells will not significantly decrease the operational capacity or degrade the water quality of the proposed well at the anticipated permanent design pumping rate.~~.

~~3.9~~3.10 Disinfection of Wells

A. Requirements

All wells are to 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.

B. Procedure

~~**1.** encrustation and bacterial slime shall be removed from the well prior to disinfection.~~

~~**2.**~~**1.** Disinfectant shall be slowly poured into the well by wetting the inside casing circumference, drop pipe and electrical cable.

~~**3.**~~**2.** Disinfectant concentration in the water column shall be initially at least one hundred milligrams per liter chlorine. AWWA specification, C654-~~97~~13~~, Appendix A~~, can be consulted to determine the necessary amount of sodium or calcium hypochlorite needed. For bleach, the following formula can be used:

$(R)^2(D)(0.000272)$ = 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

$(3)^2(40)(0.000272) = 0.097$ 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.

~~4.~~**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.

~~5.~~**4.** Cap the well and allow it to stand at least eight hours.

~~6.~~**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 forty-eight hours after disinfection and after all residual chlorine is completely flushed from the well. Total chlorine shall be tested, noted on the sample submission form, and found to be undetectable before total coliform sampling. Two consecutive total coliform samples, at least ~~twenty-four hours~~ 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.

~~7.~~**6.** If any of the bacterial samples taken from the well in step ~~6~~5 are reported as total coliform-positive (unsafe), repeat step 1 through step ~~6~~ 5.

~~8.~~**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.

~~3.10~~3.11 Sealing of Wells That Are No Longer Used or Needed

A. 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 rules 3745-9-10 and 3745-9-07 of the Ohio Administrative Code and "The State of Ohio Regulations and Technical Guidance for Sealing Unused Water Wells ~~- 1996~~ and Boreholes (2015)."

B. Procedure

Engage a ~~hydrogeologist~~qualified ground water professional, engineer or Ohio Department of Health registered well driller familiar with proper ~~abandonment~~ sealing procedures to perform or supervise abandonment of the well. ~~Sealing shall be in accordance with rules 3745-9-10 and 3745-9-07 of the Ohio Administrative Code and~~

~~"The State of Ohio Technical Guidance for Sealing Unused Wells - 1996."~~ The ~~abandonment~~ 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 ~~any of the following conditions are present:~~ 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 I.

C. Standards

Well ~~abandonment~~ 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

4.1 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.

~~The capacity of the treatment facilities shall be at least equal to the well field capacity, as indicated in Section 3.4.C.2.~~

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.

4.2 Exemptions

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

A. The equipment is certified to meet ANSI/NSF standards stated in OAC Rule 3745-83-01 (D).

B. The public water system submits the following information:

1. For ion exchange softeners, the number and size of units, the system well capacities, the loading rate, the blending information and the method of brine disposal.

2. 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.

3. 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 Chapter 3745-81 of the OAC.

~~4.2~~4.3 Disinfection

A. 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. Gaseous chlorination should not be considered for small water systems and is not covered by this manual. Noncommunity public water systems with large or complex distribution systems should consider the installation of a chlorination system; however, chlorination shall be required upstream of a storage tank which is used for

flow equalization. ~~. Chlorination of an unsafe source is unacceptable treatment, surface water treatment must be provided.~~If a well has a total coliform-positive result, additional treatment may be required.

B. 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)	

   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.

   Figures 5 and 6 illustrate typical chlorination installations.

C. 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.

~~1.~~ 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

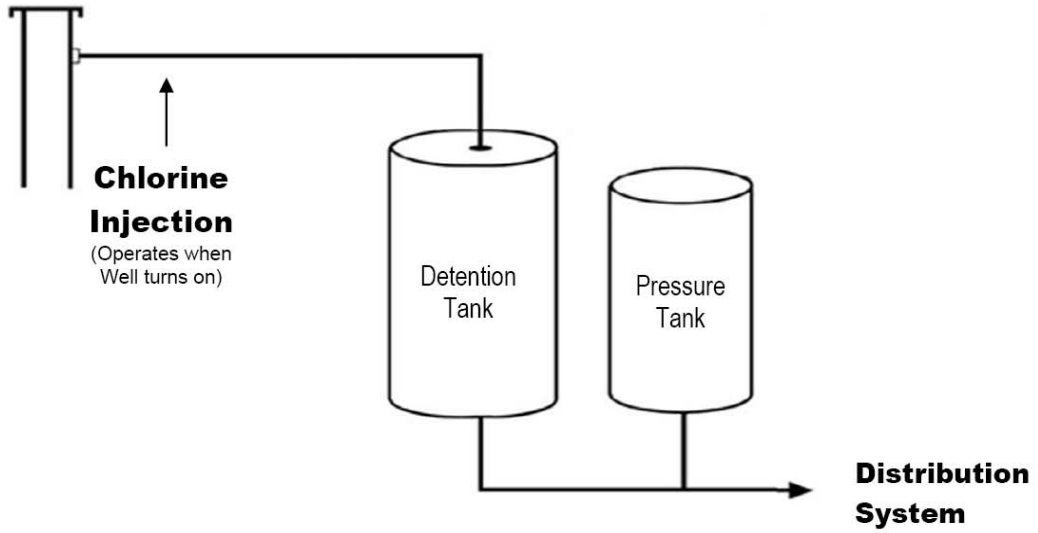
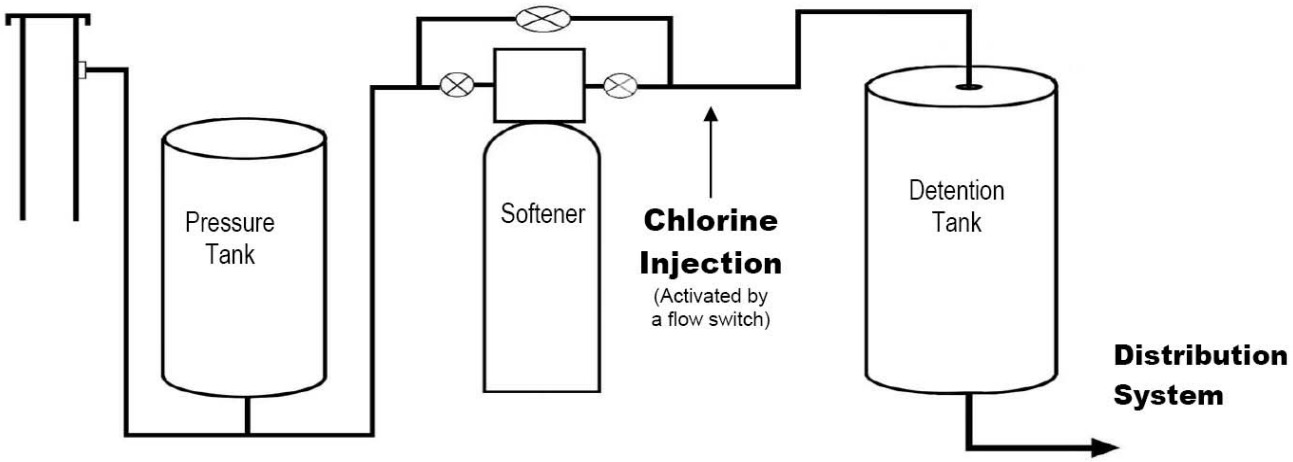


FIGURE 6: DISINFECTION WITH ION EXCHANGE SOFTENING



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 3745-9-05~~(S)(4)~~). ~~The ability to comply with this requirement must be considered when determining the location of the pressure tank.~~ A check valve 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 ~~a continuous, uninterruptible supply to downstream components in addition to providing~~ 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~~4.4 Iron and Manganese Removal

A. 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 develop a new source or change a source shall provide treatment for:

   a. Iron, if the level of iron at the entry point to the distribution system increases and 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 increases and exceeds the SMCL set forth in OAC Rule 3745-82-02.

B. 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.

C. Monitoring Requirements

1. Community systems serving up to and including two hundred and fifty persons shall monitor for iron and/or manganese in one of the following:

   a. Weekly with an acceptable in-house test kit and one split sample monthly by a certified laboratory.

   b. Weekly by a state certified laboratory.

2. Community systems serving greater than two hundred fifty persons shall monitor for iron and/or manganese in one of the following:

   a. A minimum of five days per week with an acceptable in-house test kit and one split sample monthly by a certified laboratory.

   b. Weekly by a state certified laboratory.

3. In-house test kits must have the minimum detection levels for iron and/or manganese set forth in OAC Rule 3745-83-01 ~~sections (F)(5)(c) and (F)(6)(c) respectively~~. Allowable deviations of the split samples are also included within the referenced sections.

~~C.~~D. 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.

1. **Aeration/Pressure Sand Filtration:** Aeration followed by filtration is an acceptable means for iron removal. Aeration provides precipitation of dissolved iron through oxidation by the oxygen in the air. For more information on types and design requirements refer to Section 4.7 in “Recommended Standards for Water Works” (2012).

2. **Ion Exchange:** The use of ion exchange softening as a method of iron removal is limited by the following guidelines:

   a. When the iron content is below 1.5 mg/L, and the resident population is 250 persons or less, iron/manganese removal by ion exchange softening is acceptable.

   b. When the iron content is below 1.5 mg/L, and the resident population is between 250 and 500 persons or the water usage is less than 50,000 gpd, iron/manganese removal by ion exchange softening shall be discussed with the District Representative prior to submitting the plans.

   c. When the iron content is above 1.5 mg/L, or the resident population is above 500 or the water usage is above 50,000 gpd, iron/manganese must be removed prior to any ion exchange softening equipment.

~~**Chapter 2**~~

~~**Chapter 3** The blended water delivered to the distribution system should be noncorrosive, with a total hardness of at least 80 mg/L (5 grains/gallon) expressed as CaCO3. The recommended range for finished water hardness for lead and copper corrosion control is 120 mg/L to 150 mg/L (7 to 9 grains per gallon) expressed as CaCO3. If blending results in an exceedance of the secondary iron or manganese levels then iron and manganese removal prior to softening may be required.~~

~~a.~~**d.** Ion exchange removal of only manganese is acceptable regardless of population or water usage provided that the blended water is not corrosive.

~~2.~~**3. Chlorine Oxidation/Pressure Sand Filtration:** In general, this procedure is more applicable to the removal of iron than of 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.

~~3.~~**4. Permanganate Oxidation/Manganese-Coated Sand Pressure Filtration:** In general, this procedure is more applicable to the removal of manganese and iron, than of iron alone. Manganese-coated sand can be used in either of two procedures to oxidize the manganese in the water to its insoluble state. One procedure involves batch generation of the sand using potassium permanganate. In the batch procedure, the manganese coating on the sand is the oxidizing media. The other procedure involves a continuous feed of potassium permanganate with or without chlorine. In the continuous feed procedure, oxidation is directly from the potassium permanganate or indirectly from filtering through the sand. Continuous regeneration is preferred, particularly if the backwash is discharged to an onsite sewage plant.

~~4.~~**5. Sequestration by Polyphosphates:** This process shall not be used when iron, manganese or combination thereof exceeds 1.0 mg/L. This process shall not be

used for new community public water systems. The total phosphate applied shall not exceed 10 mg/L as PO_4. ~~Where phosphate treatment is used, satisfactory chlorine residuals must be maintained in the distribution system.~~ Possible adverse effects on corrosion must be addressed when phosphate addition is proposed for iron sequestering. Stock phosphate solution must be kept covered and disinfected by carrying approximately 10 mg/L free chlorine residual. Phosphate solutions having a pH of 2.0 or less may be exempted from this requirement. Polyphosphates shall not be applied ahead of iron and manganese removal treatment, with the possible exception of ion exchange softeners. The point of application shall be prior to any aeration, oxidation or disinfection, if no iron or manganese removal treatment is provided.

FIGURE 7: IRON REMOVAL

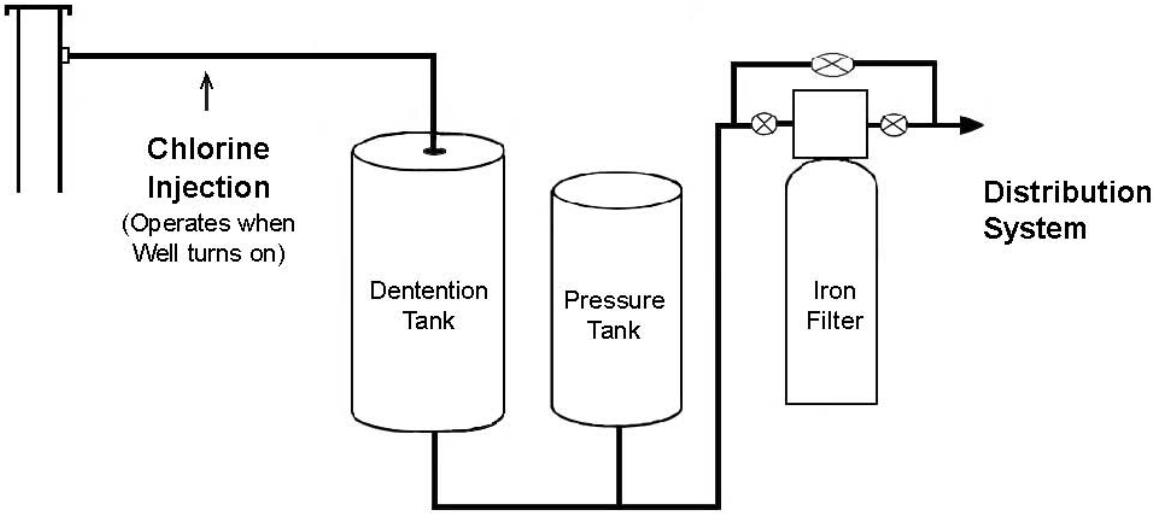
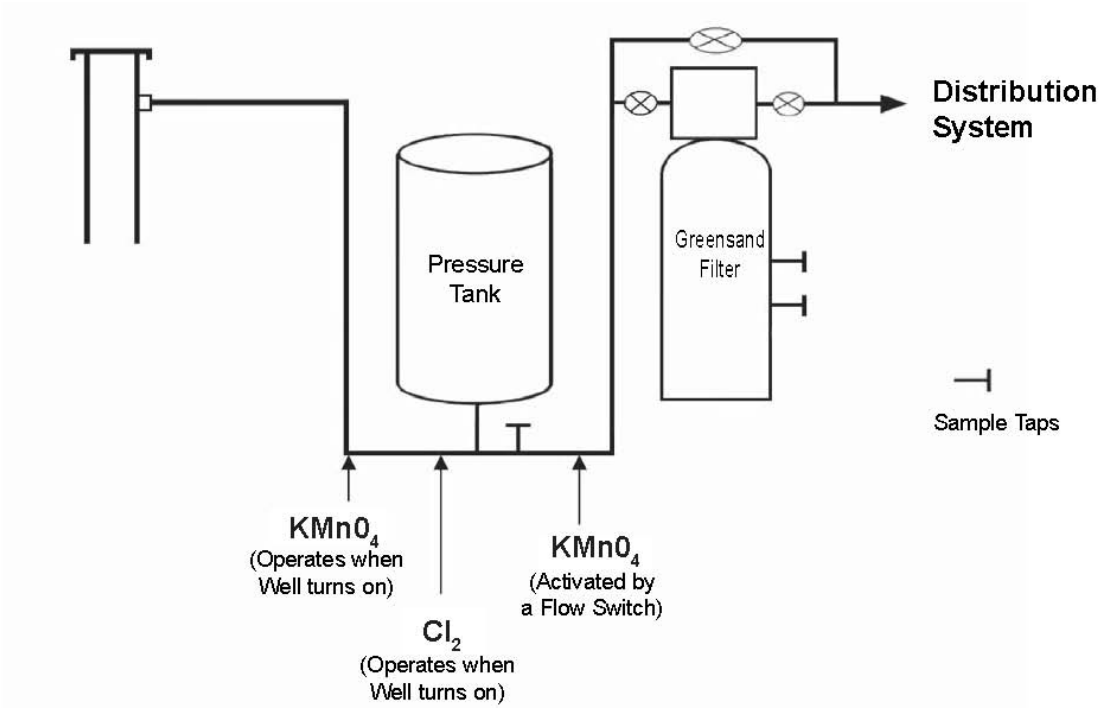


FIGURE 8: IRON AND MANGANESE REMOVAL



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 3745-9-05~~(S)(4)~~). ~~The ability to comply with this requirement must be considered when determining the location of the pressure tank.~~ A check valve 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 ~~a continuous, uninterruptible supply to downstream components in addition to providing~~ 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.

FIGURE 9: IRON REMOVAL AND ION EXCHANGE SOFTENING

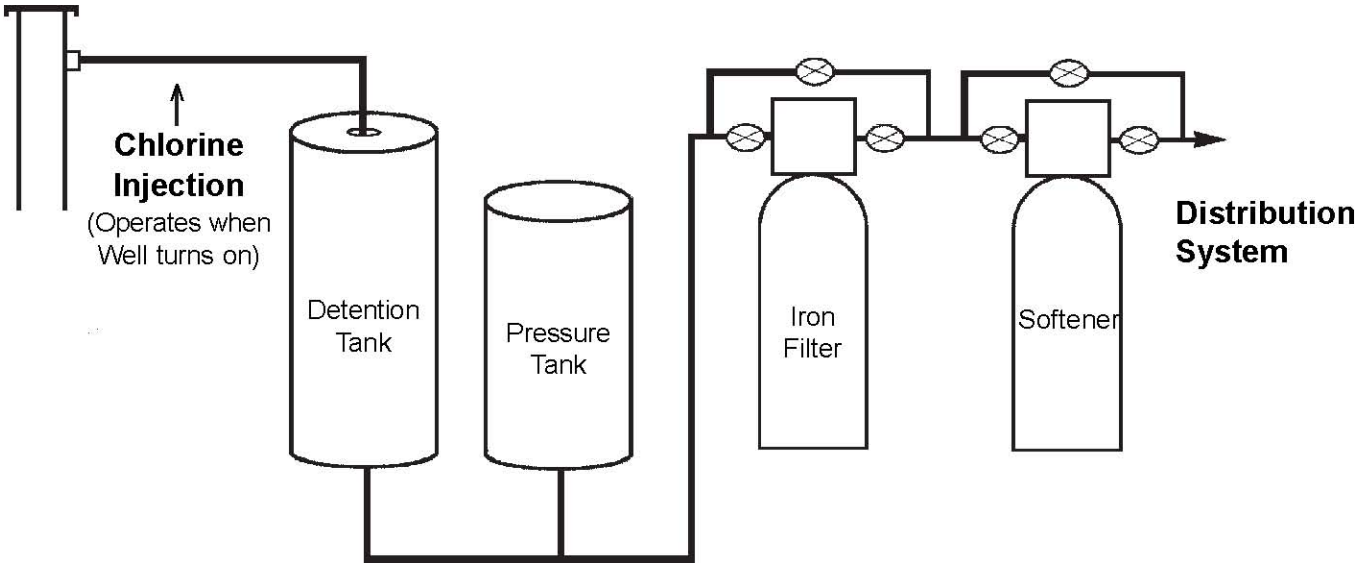
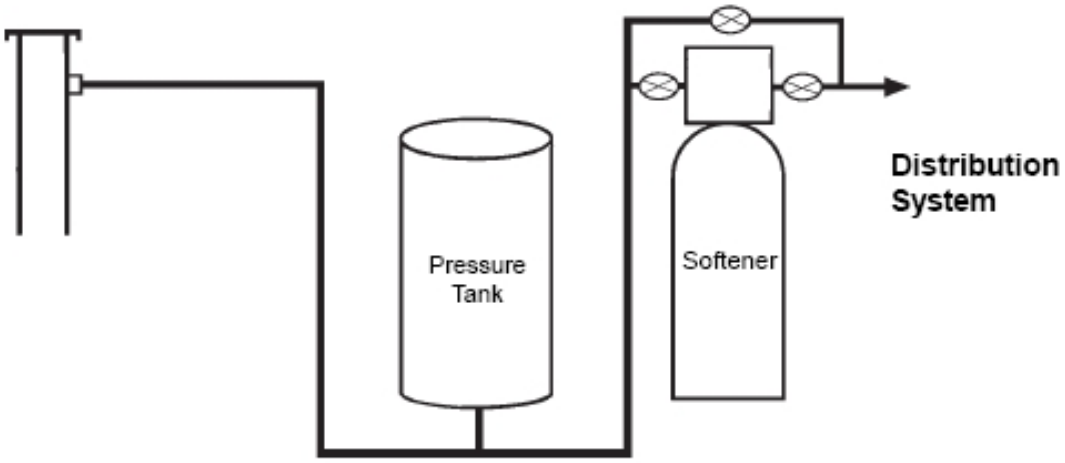


FIGURE 10: ION EXCHANGE SOFTENING



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 3745-9-05~~(S)(4)~~). ~~The ability to comply with this requirement must be considered when determining the location of the pressure tank.~~ A check valve 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 ~~a continuous, uninterruptible supply to downstream components in addition to providing~~ 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.

~~B.~~E. General Filtration Standards

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

1. Normal filtration rates shall not exceed 3 gpm/sf. Higher filtration rates for alternative media may be permitted based on data submitted to the District Office.
2. Red water waste (backwash) shall be discharged to a sanitary sewer or through a red water filter. (See Section 4.7.)
3. Backwash lines must be installed in a manner so as to prevent back-siphonage.
4. A bypass must 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.

~~C.~~F. 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 ~~20 to~~ 30 minutes detention time shall be provided. Where chlorine oxidation is used, this detention time ~~is recommended to~~ shall be at least 2~~3~~0 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.

~~D.~~G. 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. ~~at a point between the anthracite media and the manganese greensand, and halfway down the manganese greensand.~~ Two feed points are required for the potassium permanganate. One point should be as far ahead of the filter as possible and the second point should be immediately ahead of the filter. The rate of reaction is pH dependent.
2. Other oxidizing agents or processes, such as chlorination or aeration, may be used prior to the permanganate feed to reduce the usage of potassium permanganate.
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. Traditionally, greensand (a natural zeolite mineral, 0.30 to 0.35 mm effective size, uniformity coefficient no greater than #1.85) is used as the sand base. ~~In the past 20 years, p~~Proprietary in-place applied manganese coating methods have been developed for silica sand (0.45 to 0.55 mm effective size, uniformity coefficient no greater than #1.65).
6. 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.

~~E.~~H. Other Available Media

Other media can be considered based upon proven performance with applicable water quality. Table 1 ~~shown on the following pages,~~ provides general information regarding alternative media and treatment and is a guide for design purposes. Additional raw water quality information may have an impact on the final design. Contact your District Office for additional information.

In an attempt to modernize this publication, it is recognized these alternative ~~treatments~~media types are becoming more common and accepted. This section provides general design criteria that should be followed. In most cases, manufacturer's design criteria will be accepted unless the District Office's experience determines other criteria or more stringent standards should be followed. In the event design criterion from U.S. EPA becomes available, the U.S. EPA standards shall prevail over manufacturer's criteria.

TABLE 1: GENERAL MEDIA GUIDANCE

Type of Media	Media				Flow Thru Vel (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 (%)
Sand	0.45 – 0.55	< 1.65	24 – 30	~100	3	N/A	N/A	N/A	15 – 20	
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	
Birm	0.48 – 0.59	1.96 – 2.71	30 – 36	44-50	3.5 – 5.0	N/A	N/A	N/A	8 – 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 (Filter Ag)	0.67	1.8	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		Tap Locations
	pH	Dissolved Oxygen	Practical Influent Conc.	Type Contact Time	Batch	Continuous	
Pressure Sand				Cl_2: 20 minutes Air: 30 minutes			Filter Influent Filter Effluent
Manganese Greensand	6.2 – 8.5	Not required	$[H_2S]$ = 5 mg/L $[Fe^{+2}]$ = 15 mg/L $[Mn^{+2}]$ = 15 mg/L	$KMnO_4$ and/or chlorine or aeration	Manganese is primary target	Iron is primary target	Batch: Filter Influent and Effluent Continuous: Also before oxidant; ~~A~~at anth./media interface; and halfway through media bed depth
Manganese-Coated Filter Sand	6.2 – 9.0	Not required	$[H_2S]$ = 2 mg/L $[Fe^{+2}]$ = 15 mg/L $[Mn^{+2}]$ = 5 mg/L Other[1]	$KMnO_4$ and/or Cl_2	Filters up to 3 ft^3	Filters over 3 ft^3	Batch: raw, influent~~,~~ and effluent Continuous: Also at anth./media interface~~,~~ and halfway through media bed depth
Birm			Alkalinity > 2 x ($[SO_4]$+ $[Cl]$) Other[2,3]	Continuous $KMnO_4$ and/or chlorine or aeration. $KMnO_4$ added at and immediately before filter	N/A	N/A	Raw Filter Influent Filter Effluent
Granular Manganese Dioxide Media	6.2 – 8.5	Not required	Other[1]		$KMnO_4$ for 30 minutes	Cl_2 or $KMnO_4$ or both	
Manganese-Coated Sand	6.2 – 8.5	Not required					
Non-Hydrous Silicon Dioxide	Wide range			Air: 30 minutes Cl_2: 20 minutes			Filter Influent Filter Effluent
Ceramic Media							

[1] No polyphosphates prior to filter

[2] No oils present

[3] No H_2S. Free chlorine < 0.5 mg/L

1. **Manganese-Coated Filter Sand ~~(Greensand Plus)~~**

   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 ~~shall~~should have an effective size range of 0.3 mm to 0.35 mm and an uniformity coefficient no greater than 1.6.

   g. A minimum filter backwash rate of 12 gpm/sf sh~~all~~ould be provided.

2. **Activated Manganese-Coated Filter Sand ~~(e.g., BIRM, MTM, and others)~~**

   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 velocity 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.

(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.

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. Filter AG Media (Non-~~h~~Hydrous S~~s~~ilicon D~~d~~ioxide ~~filter m~~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 ~~the~~ 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 a uniformity coefficient no greater than 1.8.

(5). A minimum filter backwash rate of 10 gpm/sf shall be provided.

~~Manganese removal with non-hydrous silicon dioxide filter media will require a successful pilot.~~

4. Ceramic Media ~~(e.g., Macrolite)~~

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 considered aesthetic treatment units. They are often associated upstream of small ion exchange units.

A water system may be exempt from applying for plan approval regarding the installation of these filters. (See Section 4.2.)

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.

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

4.44.5 Ion Exchange Softening

A. 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.

~~When softening is employed, a blended water having a finished hardness of 120 to 150 mg/L (7 to 9 grains per gallon) is recommended.~~ The blended water delivered to the distribution system should be noncorrosive, with a total hardness of at least 80 mg/L (5 grains/gallon) expressed as $CaCO_3$. The recommended range for finished water hardness for lead and copper corrosion control is 120 mg/L to 150 mg/L (7 to 9 grains/gallon) expressed as $CaCO_3$. If blending results in an exceedance of the secondary iron or manganese levels, iron and manganese removal prior to softening may be required.

When ion exchange is used for iron and/or manganese removal, see ~~Section 1.1 D. 2~~OAC Rule 3745-91-09 for requirements~~, procedures and standards~~.

B. Procedure

The procedure is to exchange the hardness ions of 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. Flow diagrams on pages 35 and 36 show typical ion exchange softening installations. Design of the ion exchange softening system shall conform to the following standards:

1. The rate of softening should~~all~~ not exceed 7 gpm/sf or 3.5 gpm/ft^3 of resin. Higher softening rates may be accepted by the District Office if proper documentation is submitted.
2. The backwash rate should~~all~~ be 6 to 8 gpm/sf.
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. Backwash, rinse, and air relief discharge pipes shall be installed in such a manner as to prevent any possibility of brine waste back-siphonage.
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 ~~shall~~ 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 4.7.)
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.

NOTE: *Fully softened water should be avoided when possible as it will likely produce corrosive water and other related problems. The blended water delivered to the distribution system should have a total hardness of at least 80 mg/L expressed as $CaCO_3$. The recommended range for finished water hardness is 120 mg/L to 150 mg/L (7 to 9 grains per gallon) expressed as $CaCO_3$. Alkali addition may be necessary to stabilize the softened, blended water.*

~~4.5~~4.6 Additional Treatment Methods

A. ~~This publication includes treatment design criteria for commonly accepted iron, manganese, and hardness removal. Additional t~~Treatment methods such as arsenic and radiological removal, reverse osmosis~~, and~~ and ultraviolet light for inactivation credit ~~disinfection, and alternative filter media historically we~~ 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.~~The design of these and other technologies are beyond~~

~~the scope of this manual. Contact your Ohio EPA District Office Division of Drinking and Ground Waters engineer for information regarding additional treatment methods not discussed here.~~: 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 should be provided at a pH of 7.0, increasing 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 occurs.

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 ~~is provided~~. 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 chorine 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 addition. This must be taken into account with the system design, particularly if the water system is a community or nontransient~~,~~ noncommunity public water system.

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.

B. 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. These systems are not intended 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:

1. The Class B UV system is required to deliver a minimum UV dose of 16 mJ/cm^2 that is sufficient to inactivate nonpathogenic organisms.
2. 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.
3. Pre-treatment may be required dependent upon raw water quality.
4. Routine cleaning and maintenance is required.

~~4.6~~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 may be required.

A. Requirements

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

Permit-to-install (PTI) applications must be filed and PTIs 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 initiation of the disposal practice.

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.

B. 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 ~~requirements~~ recommendations shown in the booklet "Sewage Collection, Treatment and Disposal Where Public Sewers Are Not Available," and "Interim Onsite Sewage Treatment System Guidance Document," ~~and Disposal Where Public Sewers Are Not Available,"~~ published by Ohio EPA's Division of Surface Water.
2. **Iron Removal Filter Backwash:** Backwash water from iron and/or manganese removal ~~plants~~ must be disposed of by one of the following methods:
   - **a. 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 will need to be obtained for this flow equalization tank system.
   - **b. Discharge Through an Approved Red Water Filter:** Red water filters shall meet the following design criteria:
     - **(1).** 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 backwashings. No more than 2 feet of backwash water shall accumulate over the sand surface.
     - **(2).** 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.
     - **(3).** 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.
     - **(4).** Overflow devices shall not be permitted.

(5). The location of the sand filters and the design of the under-drainage system shall be such that water supply wells are not contaminated.

(6). Adequate freeboard shall be provided.

(7). An NPDES permit and PTI will be required.

(8). The filter must be constructed to provide for routine cleaning.

C. 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 can 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.

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.

D. 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

5.1 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 ~~instantaneous~~ hourly demand (ten times the average daily demand), storage will be required to meet system demand. (See Section 3.5C.2.)

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 State Insurance Services Office should be met where fire protection is provided.

5.2 Clearwell Storage

Clearwell storage shall meet the same standards as those for ground level storage. 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.

5.3 Ground Level Storage

A. 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.
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 should terminate in an inverted “U” at least 24 inches above ground level.
8. A minimum 24 inch diameter access manhole should be located above the waterline and should be elevated not less than 24 inches above the surrounding ground level.

The access manhole should 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. 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.

B. Fiberglass Tank Standards

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

1. General standards in 5.3 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.

5.4 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.

A. 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.

B. 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~~ four 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, a four mesh corrosion resistant screened vent and an OSHA approved access ladder.
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.

5.5 Hydropneumatic Tanks

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

A. 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.

5.6 Constant Pressure Systems

Constant pressure technology is becoming an increasingly popular alternative for water well systems. Methods available to control water pressure in these types of systems include specially-designed control valves and the use of variable frequency drives (VFDs), also known as variable speed pumps.

A. Variable Frequency Drives

Water systems using a VFD are capable ~~in~~ 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 ~~which can~~ 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. Special consideration should be given to ensuring distribution water quality will not be negatively affected due to poor water circulation or tank turnover. Power requirements and repair skills of the water system staff should also be considered.

B. 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. Follow manufacturer's specifications regarding the sizing requirements for surge tanks when VFD pumps are used.

Chapter 6

DISTRIBUTION

6.1 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.

6.2 Standards

A. 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. The design shall assure freedom from contamination.

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.

B. 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).

~~A.~~ C. 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. ~~Recommended valve spacing should be between 500 and 800 feet.~~ 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.

D. Flushing Hydrants

~~Fire Hydrants: Water mains which are not designed to carry fire flows shall not have fire hydrants connected to them. Fire hydrants shall not be installed on water mains less than 6 inches in diameter nor be fed by mains less than 6 inches in diameter.~~

~~When fire protection is to be provided, the hydrants shall be designed and installed as follows:~~

~~Hydrants should be provided at each street intersection and at intermediate points between intersections as recommended by the State Insurance Services Office. Generally, hydrant spacing should range from 350 to 600 feet depending on the area being served.~~

~~Fire hydrants should have a bottom valve size of at least 5 inches, one 4-1/2 inch pumper nozzle and two 2-1/2 inch nozzles, or consistent with requirements of the fire department serving the area.~~

~~The hydrant lead shall be a minimum of 6 inches in diameter. Auxiliary valves shall be installed in all hydrant leads.~~

~~Hydrant drains should be plugged. When the drains are plugged, the barrels must be pumped dry during freezing weather. Where hydrant drains are not plugged, a gravel pocket or dry well shall be provided unless the natural soil will provide adequate drainage. Hydrant drains shall not be connected to or located within 10 feet of sanitary sewers or storm drains.~~

~~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.

~~B.~~E. 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.

~~C.~~F. 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.

~~D.~~G. 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 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.

~~E.~~H. Exceptions

When it is impossible to obtain the minimum specified horizontal and vertical isolation, the reviewing authority ~~must~~ shall approve any variance from the requirements of Section~~s 1.1F and 1.1G~~ 6.2. Where gravity sewers are being installed and Section~~s 1.1F and 1.1G~~ 6.2 cannot be met, the following methods of installation may be used.

Such deviation may allow installation of the water main 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.

~~F.~~I. 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.

~~G.~~J. Testing

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

~~H.~~K. Disinfection

All new distribution systems shall be disinfected in accordance with AWWA C-651. Two or more sets of consecutive samples, taken at least 24 hours apart that are microbiologically safe, shall be obtained before putting a new line into service.

6.3 Backflow Prevention and Cross-Connection Control

A. 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).

B. Booster pumps shall not be approved on individual service connections to one, two or three family dwellings unless an air gap separation is provided.

C. Private wells should be properly abandoned 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 is included in Appendix L.

D. 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.

E. 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 WATER SUPPLY DATA SHEET

Ohio Environmental Protection Agency

Division of Drinking and Ground Waters

Water Supply Data Sheet

County	Township	PWS ID No.	STU ID No. (Treatment plants only)

Name and address of the public water system which will own this project:_____
_____ Phone:_____

Name of the water system which will bill:

Title of the project:

Specific location of project:

Will the proposed facilities be owned by the public water system upon their completion? Yes_____ No_____
(If "no", contact your district office for instruction). To acknowledge approval of the project by the owner either the plans must be signed or a letter of ownership must be received with the plans.

Does the project include the drilling, boring, digging, deepening, altering and/or logging of a well for the purpose of extracting potable water as part of a public water system required to be licensed under Chapter 6109 of the Revised Code? Yes_____ No_____

Does the project consist only of waterlines that are exempt under OAC Rule 3745-91-02~~(D)~~? Yes _____ No _____
If "yes", do not submit plans. These plans must be listed on an annual project summary due by January 15.

Does the project include the installation of sewers or an individual treatment system? Yes _____ No _____
If "yes", a Permit To Install may be required from the Division of Surface Water.

Is the area already served by sewers? Yes _____ No _____

Were the necessary permits applied for, if a stream or wetland crossing is part of the project? Yes _____ No _____

Is a ~~Capacity~~ Capability Assurance Plan required? Yes _____ No _____

Have you or do you intend to apply for project funding by Ohio EPA Water Supply Revolving Loan Account (WSRLA)/ Drinking Water Assistance Funds for a construction loan? Yes _____ No _____
In order to obtain WSRLA funding, an eligibility review (and additional information) is required. See page 2. Detailed plan approval for a WSRLA construction loan projects is contingent upon completion of review of full set of detailed plans, design specifications and construction contract documents and environmental review of detailed plans.

Name and address of person preparing the plans:_____
_____
_____
Phone:_____ E-mail:_____ Fax:_____

Provide a brief description of proposed project (e.g., wells, softening, storage, chlorination, high service pumping, water line extension: pipe type, diameter, length, number of service connections to be served by the project):_____
_____
_____
_____

Does the water plant serving this project have the capacity to supply these improvements? Yes_____ No_____ NA_____

For detail plan submittal:
Estimated cost of the water system improvements $_____
Review fee = $150.00 + (0.0035 x Estimated cost of the water system improvements) $_____
(Maximum fee is $20,000.00 not including well log fees)
Well log fee = $20.00 per well log $_____
For general plan submittal:
Review fee = $150.00 (flat rate)
Make check payable to: Treasurer, State of Ohio

For WSRLA submittal: ☐
Check box above ONLY if the project is detailed plan review exempt as a result of OAC Rule 3745-91-02 or the plans are self-certified.

For Ohio EPA use only

Revenue ID No.:_____

PAID
Amount _____ Date _____
Check # _____ Date _____

Division of Drinking and Ground Waters

Water Supply Data Sheet

INSTRUCTIONS FOR THE SUBMITTAL OF DETAIL PLANS FOR PUBLIC WATER SYSTEMS

As stated by section 6109.07 of the Ohio Revised Code and ~~section~~Rule 3745-91-02 of the Ohio Administrative Code, "No person shall begin construction or installation of a public water system, or make a substantial change in a public water system, until plans therefor have been approved by the director of environmental protection."

A public water system is defined as a system that has either 15 service connections or serves at least 25 individuals at least sixty days out of the year.

A person applying for plan review of a public water supply system pursuant to section 6109.07 of the Ohio Revised Code shall pay a fee of $150 plus 0.35% of the estimated project cost; however, the total fee shall not exceed $20,000. The fee shall be paid at the time the application is submitted. The fee shall be made payable to: Treasurer, State of Ohio.

If the project includes the drilling, boring, digging, deepening, altering and/or logging of a well for the purpose of extracting potable water as part of a public water system required to be licensed under Chapter 6109 of the Revised Code, include a $20.00 well log filing fee per well log in the review fee calculation. Ohio EPA is required to collect this fee for ODNR.

ALL DETAIL PLAN SUBMITTALS ARE TO CONTAIN THE FOLLOWING:

1. Water Supply Data Sheet (1 copy)
2. Review Fee
3. Detail Plans on engineering paper (usually 24"x36") (3 sets)
4. Technical specifications if applicable (1 copy)
5. Appropriate endorsements (Owner, P.E., plan preparer) as applicable

In order to provide assistance with the preparation of detail plans, guidance sheets are available at your District Office. They describe how to prepare detail plans for ground water systems including wells and treatment, and outline the minimum information that should be presented with sets of plans for waterline extensions, booster stations and storage tanks. These guidance sheets are available upon request. In addition, if the proposed improvements are for a new community or nontransient, noncommunity public water system, or if the proposed improvements are being funded by the Ohio EPA Water Supply Revolving Loan Account (WSRLA), a Capability Assurance Plan must be submitted for approval with the detail plans. If you have any questions call the District Office.

ALL WSRLA ELIGIBILITY REVIEW SUBMITTALS ARE TO CONTAIN THE FOLLOWING:

1. General plan or project planning documentation approval; all WSRLA projects must submit a general plan or project planning documentation prior to submitting detailed plans for review. For the elements of a general plan or project planning documentation, please see http://epa.ohio.gov/Portals/28/documents/dwaf/4_WSRLA_PPD_GP.pdf
2. Electronic versions of the following: approved general plan/project planning documentation, full set of detailed plans, design specifications, and construction contract documents. Electronic versions can be sent via DVD, email or Ohio EPA FTP site.

Submit plans to:

Ohio Environmental Protection Agency
Northeast District Office
2110 E. Aurora Road
Twinsburg, OH 44087
(330) 963-1200

Ohio Environmental Protection Agency
Northwest District Office
347 N. Dunbridge Road
Bowling Green, OH 43402
(419) 352-8461

Ohio Environmental Protection Agency
Southeast District Office
2195 Front Street
Logan, OH 43138
(740) 385-8501

Ohio Environmental Protection Agency
Southwest District Office
401 East 5th Street
Dayton, OH 45402
(937) 285-6357

Ohio Environmental Protection Agency
Central District Office
P.O. Box 1049
50 West Town Street, Suite 700
Columbus, OH 43216-1049
(614) 728-3778

APPENDIX B WELL SITE APPLICATION

Ohio Environmental Protection Agency

DIVISION OF DRINKING and GROUND WATERS

WELL SITE APPLICATION

for New Public Water System Well

Complete this application as accurately and completely as possible. Ohio EPA will use the information you provide to evaluate the proposed site to determine if the site is able to meet applicable requirements for siting a potable well and to provide information regarding susceptibility to contamination and things you can do to help protect the well.

Completion of this document does **NOT** constitute approval to use the well once it has been drilled. Approval to use the well is not granted until after an acceptable set of detail plan drawings and results of required analyses ~~has~~ have been submitted to and approved by the director of Ohio EPA.

You are also responsible for obtaining all other local and state permits for the proposed well as may be required by law. In addition, if the proposed water system will include treatment devices that generate a waste stream (filter backwash, etc.), it is your responsibility to contact the Division of Surface Water, at the Ohio EPA District Office covering the county where the facility is located, for additional waste treatment requirements.

A source water approved capacity determination will be required for well fields associated with new municipal or similar type new water systems. Also, a source water approved capacity will be determined when well field improvements are part of a project that will increase the approved capacity established for existing water treatment systems or you request an increase in the approved capacity of your source water (well field). These approved capacities will be determined in accordance with "Planning and Design Criteria for Establishing Approved Capacity for: 1) Surface Water and Ground Water Supply Sources, 2) Drinking Water Treatment Plants (WTPs), and 3) Source/WTP Systems" (Approved Capacity document). See Ohio Administrative Code Chapter 3745-91 for further information. Approved capacity determinations for systems not addressed above will be determined in accordance with the Ohio EPA's "Guidelines for Design of Small Public Water Systems" (Greenbook).

- When you have completed the application, make a copy for your records and return the application along with the site map and any other drawings you may have to the Ohio EPA District Office serving the county where the water system is (or will be) located. Addresses and phone numbers for the District Offices are provided on the last page of the application.
- If you have questions about completing the application, contact your Ohio EPA District Office and ask for the Drinking Water Program county representative for the county where the public water system is located.
- An Ohio EPA representative will contact you once we have reviewed the application. If you have not been contacted within 10 – 14 days after you sent in the application, please call your District Office.
- An average timeline for the entire well approval process is shown on the next page. The amount of time required to gain well approval is site specific and can vary significantly from the average. Please discuss any specific time constraints you may have with Ohio EPA District Drinking Water staff.

Typical Timeline

Number of Days	Contact Ohio EPA to request Well Site application	Contact Well Driller	Contact a water specialist to prepare Detail Plans
1 - 5	Receive Well Site application from Ohio EPA		
7 (depends on you)	Complete application, return it to Ohio EPA		
10 - 14	Ohio EPA reviews application and schedules site visit		
1	Meet with Ohio EPA to evaluate the proposed well site		
10 - 14	Receive well site evaluation letter from Ohio EPA		
2 (depends on you)		**DRILL WELL**	
3 - 5		In the order listed: 1)conduct pumping test, 2)collect samples for chemical analysis, 3)disinfect well, 4)collect total coliform samples	
30 - 40		Receive test results from the laboratory	
10			If needed, incorporate test results into water treatment design. **Submit Detail Plans to Ohio EPA.**
21 - 60 (depends on completeness of Detail Plans)			Ohio EPA reviews Detail Plans, requests revisions if necessary
5 - 7			Once Detail Plans are acceptable, Ohio EPA issues **director's approval letter**
			Install remaining equipment as approved

PART ONE – CONTACT INFORMATION

Owning Organization **(OW)**					
Organization Name:					
Street:					
City:		State:		Zip:	
Office Phone:					

Administrative Contact **(AC):**					
Name:					
Street:					
City:		State:		Zip:	
Office Phone:		Mobile Phone:			
e-mail:					

Operating Organization (LE) (Organization responsible for the facility's operation if different from owner.)					
Organization Name:					
Street:					
City:		State:		Zip:	
Office Phone:					
Operators Name:					
Operator's Office Phone:		Operator's Mobile Phone:			

Water Treatment Plant					
Treatment Plant Name:					
Treatment Plant Physical Address					
Street:					
City:		State:		Zip:	
If no address assigned, provide a description of the plant's location:					

Well Driller/Engineer (if known)**:**					
Name:					
Street:					
City:		State:		Zip:	
Office Phone:		Mobile Phone:			
e-mail:					

Applicant**:**					
Name:					
Title:					
Street:					
City:		State:		Zip:	
Office Phone:		Mobile Phone:			
e-mail:					
Applicant Signature:		Date:			

PART TWO – WELL INFORMATION

1. a. Is the water system ☐ New ☐ Existing

   b. For existing facilities, how many wells are already located at the site? (Both in use and *not* in use) _____

2 How many wells are proposed at this time?* _____

3 Is the proposed well:

   a. a <u>replacement</u> for an existing water source? ☐ Yes ☐ No

   --If yes, do you have metered documentation of water usage? ☐ Yes ☐ No

   b. a <u>supplement</u> to an existing source? ☐ Yes ☐ No

   --If yes, how many wells are currently in use at the facility? _____

   c. an <u>existing well</u> not previously used for a public water system? ☐ Yes ☐ No

   --If yes, when was the well drilled? _____

   --If yes, well log number? (attach a copy of the well log) _____

   d. Was the well approved by the local health department for private use? ☐ Yes ☐ No

   --If yes, when was the well approved by the health department? _____

   e. Is the well easily accessible for testing, repair, cleaning, treatment, etc.? ☐ Yes ☐ No

4. Are additional wells under consideration in the future? ☐ Yes ☐ No

   --If yes, when? _____

*If more than one well is proposed at this time, answer questions 3a-e for each proposed well.
You may wish to make additional copies of this page.

PART TWO – WELL INFORMATION (continued)
For existing Community water systems only

5. If multiple wells are already in use at the site:

   1. List the quantity in gallons per minute each well pumps individually

Well Name	GPM
_____	_____
_____	_____
_____	_____
_____	_____

   2. Please describe the operation of the wells. Are they pumped simultaneously or alternately?

_____
_____
_____
_____

   3. Are the wells listed above all in the same aquifer? ☐ Yes ☐ No

      -- If no, please describe

_____
_____
_____
_____

   4. What is the proposed rate of pumping for the new well? _____

   5. Will the new well be pumped simultaneously with the existing wells? ☐ Yes ☐ No

   6. Will the new well be located in the same aquifer as any of the existing wells? ☐ Yes ☐ No

PART THREE – FACILITY DESCRIPTION

Ohio EPA will use the information on this page to determine what type of population your facility will serve, to estimate how much water your facility will need, and to determine the isolation radius for your well.

SCHOOL/DAY CARE*

No. of employees _____
Avg. no. employees/day _____
Max. enrollment _____
No. Days Open/Wk. _____

Kitchen **Y N**

CHURCH/SYNAGOGUE/MOSQUE*

No. of employees _____
Avg. no. of employees/day _____
Seating capacity _____
Other functions during the week **Y N**
If yes, describe:_____
Kitchen use during the week **Y N**

*For churches and schools that also function as day care centers, provide information for both the day care center and the church/school.

RESTAURANT/TAVERN

Hrs. of operation _____
No. of employees _____
Avg. no. employees/day _____
No. of employees working 4 days/wk ___
Seating Capacity _____
Avg. no. of customers/day _____

RETAIL/COMMERCIAL/INDUSTRIAL

(Circle One)

Hrs. of operation _____
No. of employees _____
No. of employees working 4 days/wk ___

Food Service **Y N**
Shopping Center **Y N**
Showers **Y N**

NURSING HOME/HOSPITAL/INSTITUTION

Max. No. of Beds _____
No. of employees _____
Resident _____
Non-Resident _____
Avg. No. Employees/Day _____

CLUBS/MEETING HALLS

Max. Occupancy _____
Food Service **Y N**
No. Days/Yr Operating _____

CAMPGROUNDS/VACATION COTTAGES

Length of. Season _____
Max. No. of Units _____
trailer/tent spaces _____
persons (cottages) _____
Describe any additional amenities:

MOBILE HOME PARKS

No. of spaces/lots _____

ALLOTMENT/SUBDIVISION

No. of Single-Family Homes _____
No. of Multi-Family Homes _____

APARTMENT COMPLEX

No. of one-unit apts _____
No. of two-unit apts _____
No. of three-unit apts _____

OTHER (Describe Facility)

_____
_
Hrs of operation _____
No of visitors/customers _____
No. of employees _____
Avg no. employees/day _____
No. of employees working 4 days/wk _____
Seating capacity/service connections, etc: ____

PART FOUR – SITE MAP & DRAWINGS WORKSHEET

A. Site Map

A site map must be provided in all cases. Without it, Ohio EPA will consider the application incomplete and will contact you to complete this information.

*All site maps should be to scale, including a **north arrow and the scale used**, and show all of the features listed below that exist within **400 feet** of where you intend to drill your well(s). Possible sources for maps include tax maps, plat maps and county maps.*

Indicate the proposed location of your **well(s)** as accurately as possible. If any other wells exist on your property, show their locations and label them as "currently in use" or "not in use."

1. Property lines.

2. Location of any easements needed for access to well(s).

3. Existing or proposed water bodies (streams, ponds, waterways or ditches).

4. Roads and railroads.

5. Buildings.

6. Potential contaminant sources. These include, but are not limited to:

    a. wastewater treatment systems and septic tanks, including their discharge locations
    b. oil and gas production wells (active or capped)
    c. mining operations
    d. waste or product storage tanks (above or below ground)
    e. landfills, old or new refuse disposal areas and demolition fill areas
    f. pipe lines (sewer mains, gas mains, oil mains, etc.)
    g. manufacturing facilities
    h. fields subject to application of manure, treated wastewater, pesticides or fertilizer

B. Other Drawings

If you already have **drawings, blueprints, or other maps** of your facility, particularly those showing how water will be used within the building and where pressure tanks, softeners, and other treatment units will be placed, please include one copy of those drawings with this application. Such drawings are *not* required at this time, but will be required as part of the detail plan package you will need to submit and have approved after the well has been drilled.

Return completed application, site map, and other drawings (if applicable) to Ohio EPA – Division of Drinking and Ground Waters at your local District Office:

Northwest District Office
347 North Dunbridge Road
Bowling Green, Ohio 43402-9398
(419) 354-8461

Central District Office
P.O. Box 1049
Columbus, Ohio 43216-1049
(614) 728-3778

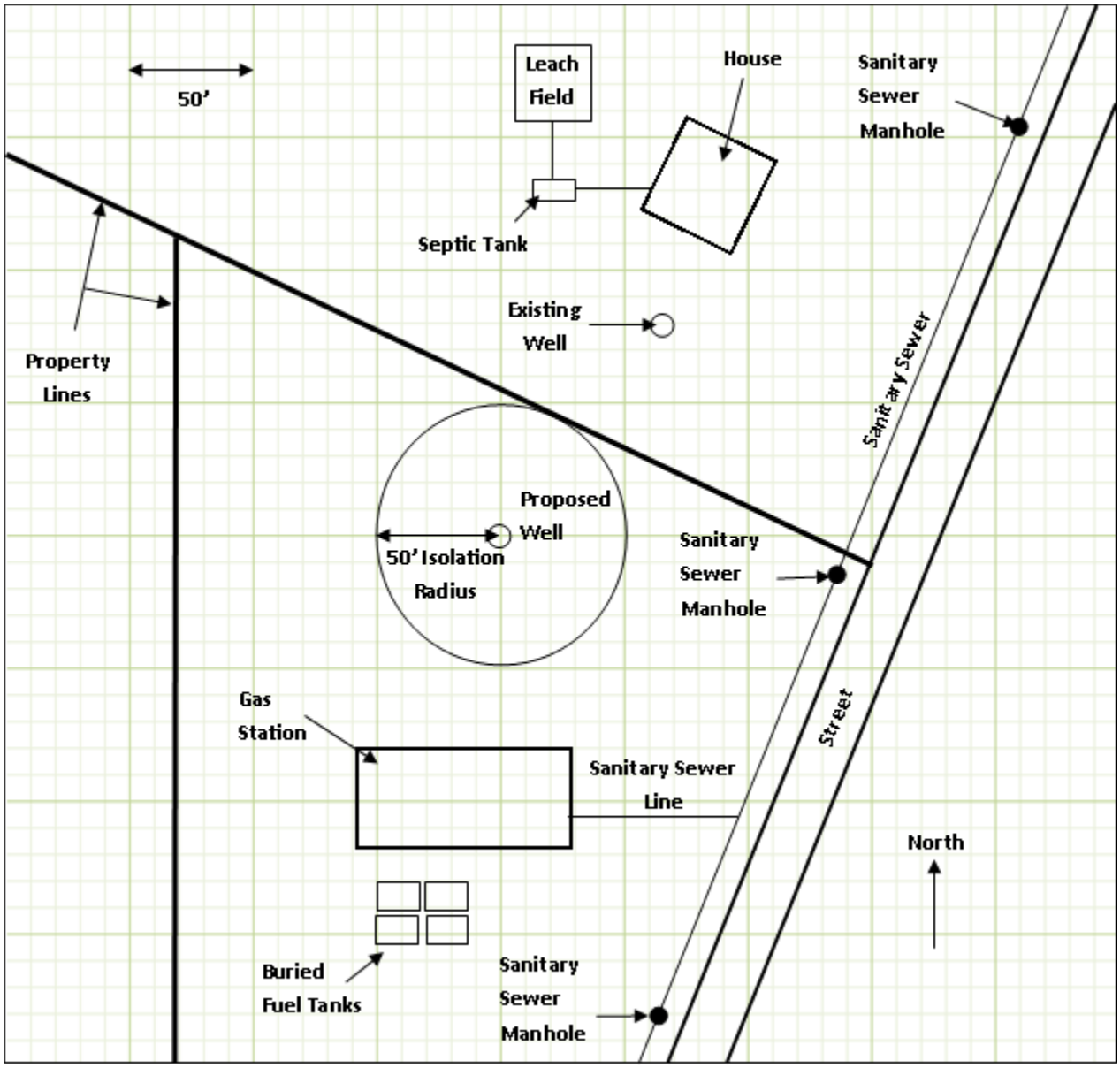
Northeast District Office
2110 East Aurora Road
Twinsburg, Ohio 44087
(330) 963-1200

Southeast District Office
2195 Front Street
Logan, Ohio 43138
(740) 385-8501

Southwest District Office
401 East Fifth Street
Dayton, Ohio 45402
(937) 285-6357

APPENDIX C EXAMPLE WELL SITE MAP

EXAMPLE WELL SITE MAP



APPENDIX D SUGGESTED WATER USAGE GUIDE

Ohio Environmental Protection Agency, Division of Drinking and Ground Waters

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 & Toilets (per person)	20
Primitive Camp (per person)	5
Recreational Vehicle/Travel with Centralized Comfort Station without Water & Sewer (per space)	75
Recreational Vehicle with Water & Sewer Hookup (per space)	125
Swimming Pools (per swimmer)	5
Youth & 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 & 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/Correction 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 1st bay or pump island)	1,000
Service stations (additional bay or pump island)	500

Facility Type (cont.)	Gallons per Day
Residential Communities	
Apartment, One Bedroom	250
Apartment, Two Bedroom	300
Apartment, Three Bedroom	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
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 seal)	50
Schools	
Boarding (per person)	10
Elementary/Day Care (per person)	15
High & Jr. High (per person) 20	20
Theaters	
Drive-In (per car space)	5
Movie (per seat)	3

APPENDIX E SAMPLE ODNR WELL LOG AND DRILLING REPORT

SAMPLE ODNR WELL LOG AND DRILLING REPORT

DNR 7802.06
TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Divison of Water, 1939 Fountain Square Drive
Columbus, Ohio 43224-9971 Voice (614) 265-6739 Fax (614) 447-9503

WELL LOCATION

County Delaware Township Trenton

Owner/Builder (Circle One or Both) E. J. Fudd (First / Last)

Address of Well Location 181 Green Cook Rd. (Number / Street Name)

City Sunbury Zip Code +4 43074-9761

Permit No. 960.95 Section/Lot No. (Circle One or Both) 20

Location of Well in State Plane coordinates, if available: Use of Well Residential

N ☒ X 195339 . 425 +/- 20 (ft or m)

S ☐ Y 1922944 . 533 +/- 20 (ft or m)

Elevation of Well 1084 . +/- 5 (ft or m)

Datum Plain: ☒ NAD27 ☐ NAD83 Elevation Source Topo map

Source of Coordinates: ☒ GPS ☐ Survey ☐ 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: 40°12'09" Long: 82°46'35"

WELL TEST*

Pre-Pumping Static Level 20 ft. Date 12/10/95

Measured from: ☒ Top of Casing ☐ Ground Level ☐ Other

☒ Air ☐ Bailing ☐ Pumping* ☐ Other

Test Rate 35 gpm Duration of Test 1 hrs.

Feet of Drawdown 20 ft. Sustainable Yield 25 gpm

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

Is Copy Attached? ☐ Yes ☒ No Flowing Well? ☐ Yes ☒ No

Quality Clear, 1ppm Fe, 30 gpg hardness, pH 7

PUMP/PITLESS

Type of pump Submersible Capacity 10 gpm

Pump set at 65 ft. Pitless Type Adapter

Pump installed by Acme Drilling Co.

I hereby certify the information given is accurate and correct to the best of my knowledge.

Drilling Firm Acme Drilling Co.

Address 1234 Main St.

City, State, Zip Anytown, Ohio 56789

Signed W.E. Coyote Date 1/23/96

ODH Registration Number 1111

CONSTRUCTION DETAILS

☒ Rotary ☐ Cable ☐ Augered ☐ Driven ☐ Other

BOREHOLE/CASING (measured from ground surface)

1 ☒ Borehole Diameter 7 7/8 inches Depth 127 ft.
Casing Diameter 5 in. Length 20 ft. Thickness .327 in.

2 ☐ Borehole Diameter inches Depth ft.
Casing Diameter 5 in. Length 102 ft. Thickness .265 in.

Casing Height Above Ground 1 ft.

Type 1 ☐ 2 ☐ Steel 1 ☐ 2 ☐ Galv. 1 ☒ 2 ☒ PVC 1 ☐ 2 ☐ Other

Joints 1 ☐ 2 ☐ Threaded 1 ☐ 2 ☐ Welded 1 ☒ 2 ☒ Solvent 1 ☐ 2 ☐ Other

SCREEN

Diameter 5 in Slot Size .050 in Screen Length 5 ft.

Type Machine-slotted Material PVC

Set Between 122 ft. and 127 ft.

GRAVEL PACK (Filter Pack)

Material/Size #4 Parry sand Volume/Weight Used 400 lbs

Method of Installation Gravity pour

Depth: Placed FROM 118 ft. TO 127 ft.

GROUT

Material Benseal/EZ Mud Volume/Weight Used 175 gal

Method of Installation Pumped through 1" tremie tube

Depth: Placed FROM 118 ft. TO surface ft.

DRILLING LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED. Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand, etc.	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'		

*(If more space is needed to complete drilling log, use next consecutively numbered form.)

Date of Well Completion 12/10/95 Total Depth of Well 127 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 F PARAMETERS REQUIRED FOR COMPLETE WELL ANALYSIS

OHIO EPA DIVISION OF DRINKING AND GROUND WATERS

PARAMETERS REQUIRED FOR COMPLETE WELL ANALYSIS FOR
COMMUNITY WATER SYSTEMS

PARAMETER	MCL / Standard	Reporting Limit
INORGANIC CHEMICALS (IOCs)		
Alkalinity Total, as CaCO3	No standard	None
Antimony Total, Sb	0.006 mg/L (6 ug/L)	4.0 ug/L
Arsenic Total, As	0.010 mg/L (10 ug/L)	3.0 ug/L
Barium Total, Ba	2 mg/L (2000 ug/L)	300.0 ug/L
Beryllium Total, Be	0.004 mg/L (4 ug/L)	1.0 ug/L
Cadmium Total, Cd	0.005 mg/L (5 ug/L)	1.0 ug/L
Calcium Total, Ca	No standard	None
Chloride, Cl	250 mg/L SMCL	None
Chromium Total, Cr	0.1 mg/L (100 ug/L)	10.0 ug/L
Copper Total, Cu	1.3 mg/L (1,300 ug/L) AL	50.0 ug/L
Cyanide, CN	0.2 mg/L (200 µg/L)	20 ug/L
Fluoride Total, F	4.0 mg/L	0.5 ug/L
Iron Total, Fe	0.3 mg/L (300 µg/L) SMCL	None
Lead Total, Pb	0.015 mg/L (15 ug/L) AL	5.0 ug/L
Magnesium Total, Mg	No standard	None
Manganese Total, Mn	0.05 mg/L (50 ug/L) SMCL	None
Mercury Total, Hg	0.002 mg/L (2 ug/L)	0.5 ug/L
Nickel Total, Ni	No standard	20.0 ug/L
Nitrate, NO3 (as N)	10 mg/L	0.5 mg/L
Nitrate-Nitrite, NO3-NO2 (as N)	10 mg/L	0.5 mg/L
Nitrite, NO2 (as N)	1 mg/L	0.1 mg/L
pH, Lab S.U.	6.5 – 8.5 SMCL	None
Selenium Total, Se	0.05 mg/L (50 ug/L)	5.0 ug/L
Silver Total, Ag	0.1 mg/L (100 µg/L) SMCL	None
Sodium Total, Na	No standard	None
Sulfate, SO4	250 mg/L SMCL	None
Thallium Total, Tl	0.002 mg/L (2 ug/L)	1.5 ug/L
Total Dissolved Solids	500 mg/L SMCL	None
Zinc Total, Zn	5 mg/L SMCL	None
RADIOLOGICALS (Rads)		
Gross Alpha	15 pCi/L MCL / 5 pCi/L AL	3 pCi/L
Gross Beta**	4 mrem/yr MCL / 50 pCi/L AL	4 pCi/L
Radium 228	5 pCi/L (sum with 226 result)	1 pCi/L
Radium 226***	5 pCi/L (sum with 228 result)	1 pCi/L
Uranium****	30 ug/L (20 pCi/L)	1 ug/L
SYNTHETIC ORGANIC CHEMICALS (SOCs)		
Atrazine	0.003 mg/L (3 ug/L)	0.3 ug/L
Alachlor	0.002 mg/L (2 ug/L)	0.2 ug/L
Simazine	0.004 mg/L (4 ug/L)	0.35 ug/L
BACTERIA STANDARDS		
Total Coliform (2 samples collected at least 30 min. apart		1 Positive = Standard Exceeded

VOLATILE ORGANIC CHEMICALS (VOCs)	
REGULATED	**MCL / Standard**
Benzene	0.005 mg/L (5 ug/L)
Carbon Tetrachloride (tetrachloromethane)	0.005 mg/L (5 ug/L)
cis-1,2-Dichloroethene (or –ethylene)	0.07 mg/L (70 ug/L)
Dichloromethane (methylene chloride)	0.005 mg/L (5 ug/L)
1,1-Dichloroethene (or –ethylene, 1,1-DCE)	0.007 mg/L (7 ug/L)
1,2-Dichloroethane	0.005 mg/L (5 ug/L)
1,2-Dichloropropane	0.005 mg/L (5 ug/L)
Ethylbenzene	0.7 mg/L (700 ug/L)
Monochlorobenzene (chlorobenzene)	0.1 mg/L (1 ug/L)
ortho-Dichlorobenzene (1,2-Dichlorobenzene)	0.6 mg/L (600 ug/L)
para-Dichlorobenzene (1,4-Dichlorobenzene)	0.075 mg/L (75 ug/L)
Styrene	0.1 mg/L (100 ug/L)
Tetrachloroethylene (or –ethylene, perchloroethylene)	0.005 mg/L (5 ug/L)
Toluene	1 mg/L (1,000 ug/L)
trans-1,2-Dichloroethene (or –ethylene)	0.1 mg/L (100 ug/L)
Trichloroethene (or –ethylene)	0.005 mg/L (5 ug/L)
1,1,1-Trichloroethane (methyl chloroform)	0.2 mg/L (200 ug/L)
1,2,4-Trichlorobenzene	0.07 mg/L (70 ug/L)
1,1,2-Trichloroethane	0.005 mg/L (5 ug/L)
Vinyl Chloride	0.002 mg/L (2 ug/L)
Xylenes (total)	10 mg/L (10,000 ug/L)

NOTE: All samples must be analyzed by a certified laboratory in accordance with OAC Chapter 3745-89. All applicable sample results must be received and approved by the Ohio EPA before the well can be considered for use as a public water source. Additional analyses beyond those listed may be required.

** Analysis of all major radioactive constituents required if gross beta result exceeds 50 pCi/L.
*** Radium 226 required if the gross alpha result exceeds 5 pCi/L or radium 228 exceeds 1 pCi/L.
**** Uranium required if the gross alpha result exceeds 15 pCi/L

ABBREVIATIONS:

MCL - Maximum Contaminant Level
MCLG - Maximum Contaminant Level Goal
mg/L - milligrams per liter (parts per million -ppm) = 1,000 ug/L
ug/L - micrograms per liter (parts per billion - ppb) = .001 mg/L
MFL - million fibers per liter
pCi/L - picocuries per liter
SMCL - Secondary Maximum Contaminant Level; Advisory limit only
AL - Action Level; requires action to be taken mrem/yr - millirem per year

OHIO EPA DIVISION OF DRINKING AND GROUND WATERS

PARAMETERS REQUIRED FOR COMPLETE WELL ANALYSIS FOR
NONTRANSIENT NONCOMMUNITY WATER SYSTEMS

PARAMETER	MCL / Standard	Reporting Limit
INORGANIC CHEMICALS (IOCs)		
Alkalinity Total, as CaCO3	No standard	None
Antimony Total, Sb	0.006 mg/L (6 ug/L)	4.0 ug/L
Arsenic Total, As	0.010 mg/L (10 ug/L)	3.0 ug/L
Barium Total, Ba	2 mg/L (2000 ug/L)	300.0 ug/L
Beryllium Total, Be	0.004 mg/L (4 ug/L)	1.0 ug/L
Cadmium Total, Cd	0.005 mg/L (5 ug/L)	1.0 ug/L
Calcium Total, Ca	No standard	None
Chloride, Cl	250 mg/L SMCL	None
Chromium Total, Cr	0.1 mg/L (100 ug/L)	10.0 ug/L
Copper Total, Cu	1.3 mg/L (1,300 ug/L) AL	50.0 ug/L
Cyanide, CN	0.2 mg/L (200 µg/L)	20 ug/L
Fluoride Total, F	4.0 mg/L	0.5 ug/L
Iron Total, Fe	0.3 mg/L (300 µg/L) SMCL	None
Lead Total, Pb	0.015 mg/L (15 ug/L) AL	5.0 ug/L
Magnesium Total, Mg	No standard	None
Manganese Total, Mn	0.05 mg/L (50 ug/L) SMCL	None
Mercury Total, Hg	0.002 mg/L (2 ug/L)	0.5 ug/L
Nickel Total, Ni	No standard	20.0 ug/L
Nitrate, NO3 (as N)	10 mg/L	0.5 mg/L
Nitrate-Nitrite, NO3-NO2 (as N)	10 mg/L	0.5 mg/L
Nitrite, NO2 (as N)	1 mg/L	0.1 mg/L
pH, Lab S.U.	6.5 - 8.5 SMCL	None
Selenium Total, Se	0.05 mg/L (50 µg/L)	5.0 ug/L
Silver Total, Ag	0.1 mg/L (100 ug/L) SMCL	None
Sodium Total, Na	No standard	None
Sulfate, SO4	250 mg/L SMCL	None
Thallium Total, Tl	0.002 mg/L (2 ug/L)	1.5 ug/L
Total Dissolved Solids	500 mg/L SMCL	None
Zinc Total, Zn	5 mg/L SMCL	None
RADIOLOGICALS (Rads)		
Gross Alpha	15 pCi/L MCL / 5 pCi/L AL	3 pCi/L
Gross Beta**	4 mrem/yr MCL / 50 pCi/L AL	4 pCi/L
SYNTHETIC ORGANIC CHEMICALS (SOCs)		
Atrazine	0.003 mg/L (3 ug/L)	0.3 ug/L
Alachlor	0.002 mg/L (2 ug/L)	0.2 ug/L
Simazine	0.004 mg/l (4 ug/L)	0.35 ug/L
BACTERIA STANDARDS		
Total Coliform (2 samples collected at least 30 min. apart		1 Positive = Standard Exceeded

VOLATILE ORGANIC CHEMICALS (VOCs)	
REGULATED	**MCL / Standard**
Benzene	0.005 mg/L (5 ug/L)
Carbon Tetrachloride (tetrachloromethane)	0.005 mg/L (5 ug/L)
cis-1,2-Dichloroethene (or –ethylene)	0.07 mg/L (70 ug/L)
Dichloromethane (methylene chloride)	0.005 mg/L (5 ug/L)
1,1-Dichloroethene (or –ethylene, 1,1-DCE)	0.007 mg/L (7 ug/L)
1,2-Dichloroethane	0.005 mg/L (5 ug/L)
1,2-Dichloropropane	0.005 mg/L (5 ug/L)
Ethylbenzene	0.7 mg/L (700 ug/L)
Monochlorobenzene (chlorobenzene)	0.1 mg/L (1 ug/L)
ortho-Dichlorobenzene (1,2-Dichlorobenzene)	0.6 mg/L (600 ug/L)
para-Dichlorobenzene (1,4-Dichlorobenzene)	0.075 mg/L (75 ug/L)
Styrene	0.1 mg/L (100 ug/L)
Tetrachloroethylene (or –ethylene, perchloroethylene)	0.005 mg/L (5 ug/L)
Toluene	1 mg/L (1,000 ug/L)
trans-1,2-Dichloroethene (or –ethylene)	0.1 mg/L (100 ug/L)
Trichloroethene (or -ethylene	0.005 mg/L (5 ug/L)
1,1,1-Trichloroethane (methyl chloroform)	0.2 mg/L (200 ug/L)
1,2,4-Trichlorobenzene	0.07 mg/L (70 ug/L)
1,1,2-Trichloroethane	0.005 mg/L (5 ug/L)
Vinyl Chloride	0.002 mg/L (2 ug/L)
Xylenes (total)	10 mg/L (10,000 ug/L)

NOTE: All samples must be analyzed by a certified laboratory in accordance with OAC Chapter 3745-89. All applicable sample results must be received and approved by the Ohio EPA before the well can be considered for use as a public water source. Additional analyses beyond those listed may be required.

ABBREVIATIONS:

MCL - Maximum Contaminant Level
MCLG - Maximum Contaminant Level Goal
mg/L - milligrams per liter (parts per million -ppm) = 1,000 ug/L
ug/L - micrograms per liter (parts per billion - ppb) = .001 mg/L
MFL - million fibers per liter
pCi/L - picocuries per liter
SMCL - Secondary Maximum Contaminant Level; Advisory limit only
AL - Action Level; requires action to be taken mrem/yr - millirem per year

OHIO EPA DIVISION OF DRINKING AND GROUND WATERS

PARAMETERS REQUIRED FOR COMPLETE WELL ANALYSIS FOR
TRANSIENT NONCOMMUNITY WATER SYSTEMS

PARAMETER	MCL / Standard	Reporting Limit
INORGANIC CHEMICALS (IOCs)		
Alkalinity Total, as CaCO3	No standard	None
Antimony Total, Sb	0.006 mg/L (6 ug/L)	4.0 ug/L
Arsenic Total, As	0.010 mg/L (10 ug/L)	3.0 ug/L
Barium Total, Ba	2 mg/L (2000 ug/L)	300.0 ug/L
Calcium Total, Ca	No standard	None
Chloride, Cl	250 mg/L SMCL	None
Copper Total, Cu	1.3 mg/L (1,300 ug/L) AL	50.0 ug/L
Fluoride Total, F	4.0 mg/L	0.5 ug/L
Iron Total, Fe	0.3 mg/L (300 µg/L) SMCL	None
Lead Total, Pb	0.015 mg/L (15 ug/L) AL	5.0 ug/L
Magnesium Total, Mg	No standard	None
Manganese Total, Mn	0.05 mg/L (50 ug/L) SMCL	None
Nitrate, NO3 (as N)	10 mg/L	0.5 mg/L
Nitrate-Nitrite, NO3-NO2 (as N)	10 mg/L	0.5 mg/L
Nitrite, NO2 (as N)	1 mg/L	0.1 mg/L
pH, Lab S.U.	6.5 - 8.5 SMCL	None
Sodium Total, Na	No standard	None
Sulfate, SO4	250 mg/L SMCL	None
Total Dissolved Solids	500 mg/L SMCL	None
RADIOLOGICALS (Rads)		
Gross Alpha	15 pCi/L MCL / 5 pCi/L AL	3 pCi/L
Gross Beta**	4 mrem/yr MCL / 50 pCi/L AL	4 pCi/L
BACTERIA STANDARDS		
Total Coliform (2 samples collected at least 30 min. apart		1 Positive = Standard Exceeded

NOTE: All samples must be analyzed by a certified laboratory in accordance with OAC Chapter 3745-89. All applicable sample results must be received and approved by the Ohio EPA before the well can be considered for use as a public water source. Additional analyses beyond those listed may be required.

ABBREVIATIONS:

MCL - Maximum Contaminant Level
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SMCL - Secondary Maximum Contaminant Level; Advisory limit only
AL - Action Level; requires action to be taken
mrem/yr - millirem per year

Revised: August 12, 2015

APPENDIX G 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: _____

COUNTY: _____ PWS-ID: _____ WELL NUMBER: _____

LOCATION DESCRIPTION: _____

CONTACT PERSON: _____ TEL: ( ) _____ FAX: ( ) _____

CONSTRUCTION DETAILS

CASING DIAMETER: _____ INCHES LATITUDE: _____

CASING LENGTH*: _____ FEET LATITUDE: _____

Determined by: ☐ Casing Depth Indicator ☐ Down-Hole Camera

DEPTH TO BEDROCK: _____ FEET _____ ELEVATION: _____

**Casing length cannot be estimated.*

OBSERVABLE DEFICIENCIES

	YES	NO	CND**
EXCESSIVE CORROSION OR PIN-HOLING OF THE CASING:			
PITLESS UNIT SECURE:			
BENT OR DENTED CASING BELOW GROUND:			
WELL GROUTED:			

***Could Not be Determined*

INSPECTED BY (DRILLING FIRM): _____

NAME OF INSPECTOR: _____

ADDRESS: _____

DATE OF INSPECTION: _____ TEL: ( ) _____ FAX: ( ) _____

SIGNATURE: _____

APPENDIX H 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: _____

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 RATE: _____ 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.

DEPTH TO WATER(S): (ATTACH)

The distance from the ground to the water surface at various times during the test. Levels shall be recorded in accordance with the following table.

Time After Pump Test Started (minute)	Time Interval Between Measurements (minute)
0-15	1
15-60	5
60-120	10
120-180	20
180-300	30
300-1,440	60

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.

RECOVERY LEVELS AT VAIOUS 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.

Pumping Test

Date (start of pump test): _____

Time (Military)	Time since pumping started	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				
	30				
	35				
	40				
	45				
	50				
	55				
	60 (1hr)				
	70				
	80				
	90				
	100				
	110				
	120 (2hr)				
	140				
	160				
	180 (3hr)				
	210				
	240 (4hr)				
	270				

Time (Military)	Time since pumping started	Depth to Water (S)	Change in Water Level (S-So)	Discharge Rate (GPM)	Comments (Include Weather Conditions)
	300 (5hr)				
	360 (6hr)				
	420 (7hr)				
	480 (8hr)				
	540 (9hr)				
	600 (10hr)				
	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): _____

Recovery

Time (Military)	Time since pumping started	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)				

Time (Military)	Time since pumping started	Depth to Water (S)	Change in Water Level (S-So)	Discharge Rate (GPM)	Comments (Include Weather Conditions)
	90				
	120 (2hr)				
	150				
	180 (3hr)				
	210				
	240 (4hr)				
	270				
	300 (5hr)				

APPENDIX I SAMPLE ODNR WATER WELL SEALING REPORT

EXAMPLE OF ODNR WATER WELL SEALING REPORT

DNR 7810.96

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 Section/Lot Number (Circle One or Both) 20

Owner/Builder (Circle One or Both) E. J. Fudd

Address of Well Location 181 Green Cook Rd.
Number Street Name

City Sunbury Zip Code +4 43074-9761

.2 miles South (n, e, s, w) of St. Rt. 37 (nearest intersection)

Property Location Description: on the East (n, e, s, w) side of Green Cook Rd. (road name)

Location of Well in State Plane coordinates, if available: N ☒ S ☐ X 1953393.43 +/- 20 (ft or m) Y 1922944.53 +/- 20 (ft or m)

Elevation of Well 1084. +/- 5 (ft or m) Datum Plain: ☒ NAD27 ☐ NAD83

Source of Coordinates: ☒ GPS ☐ Survey ☐ Other

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

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 127	To surface		Benseal/EZ Mud Slurry	130 gallons
	From	To			
	From	To			

Was Casing Removed? (Yes) or 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 ACME DRILLING COMPANY ODH Registration # 1111

Address 1234 MAIN ST.

City/State/Zip Anytown, OH, 56789

Signature W. E. Coyote
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) (9), 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 J 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:
   A. 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 is to 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 floatation concerns ~~(Section 1.1B.3)~~. 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. ~~(Section 1.1A.8)~~
6) Sanitary fill.
7) Overflow. ~~(Section 1.1A.9)~~
8) Vent. ~~(Section 1.1A.7)~~
9) Security. ~~(Section 1.1A.5)~~
10) Drain. ~~(Section 1.1A.6)~~
11) Final grading provides positive drainage away from tank. ~~(Section 1.1A.10)~~

B. Discharge pump/pressure tank:
1) Discharge pump capacity ≥ 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.

C. 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).

APPENDIX K REQUIREMENT FOR PROFESSIONAL ENGINEERING STAMP ON DRINKING WATER PLANS

REQUIREMENT FOR PROFESSIONAL ENGINEERING STAMP ON DRINKING WATER PLANS

The following types of plans involve the practice of engineering as defined by Ohio Revised Code 4733.01(D), and therefore shall have a PE Stamp:

a. Plans involving the expenditure of public funds in excess of $5,000.00.

b. Plans for the removal, inactivation or chemical treatment of a health based contaminant.

c. Plans for chemical feed systems which pose a safety risk, such as gaseous chlorine, fluoride or sodium hydroxide.

d. Plans for change or modification of coagulant feed systems at surface water treatment plants.

e. Plans for small systems which are not within the scope of the Ohio EPA Guidelines for Design of Small Public Water Systems.

~~f. Plans for community water system water line extensions costing more than $5,000.00;g~~f. Plans for elevated backwash storage tanks.

~~h~~g. Plans for booster pumping stations.

~~i~~h. Plans for onground or inground storage tanks with a capacity of greater than 50,000 gallons which are located at water treatment plants.

~~j~~i. Plans for all distribution storage tanks.

~~k~~j. General plans for community water systems, and for noncommunity water systems which are ~~not within~~beyond the scope of the Ohio EPA Guidelines for Design of Small Public Water Systems.

The following types of plans ~~do not require a PE Stamp unless they~~which involve the expenditure of public funds ~~in excess~~ of five thousand dollars or less do not require a PE Stamp:

a. Plans for new wells.

b. Plans for chemical feed systems at ground water treatment plants other than those for gaseous chlorine, fluoride or sodium hydroxide.

c. Plans for small noncommunity systems which are within the scope of the Ohio EPA Guidelines for Design of Small Public Water Systems.

d. Plans for water treatment systems which are within the scope of the Ohio EPA Guidelines for Design of Small Public Water Systems for community water systems with a capacity of 50,000 gallons per day or less.

e. Plans for emergency generators.

f. Plans for deactivation of a water treatment plant.

~~g. Community water system water line extensions costing $5,000.00 or less;~~

g~~h~~. Plans for pre-engineered onground or inground storage tanks with a capacity of 50,000 gallons or less located at water treatment plants.

~~i. Nonrequired treatment systems which will have no discernable effect;~~

h~~j~~. Lead and copper corrosion control studies and recommendations.

APPENDIX L BACKFLOW PREVENTION AND CROSS-CONNECTION CONTROL BROCHURE

If a potential or actual cross-connection contamination hazard is identified, the customer will be required to eliminate the hazard and/or install an appropriate backflow preventer at the service connection and/or at the hazard.

Special Conditions

Auxiliary Water Systems

What is an auxiliary water system?

It is any water system on or available to your property other than the public water system. Used water or water from wells, cisterns or open reservoirs that are equipped with pumps or other sources of pressure, including gravity are examples.

What protection is required?

- The auxiliary water system must be completely separated from water supply plumbing served by a public water system; and
- An approved backflow preventer must be installed at the service connection (where the public water system connects to the customer's plumbing system).

OR

- The auxiliary water system must be eliminated.

Are there exceptions?

At their discretion, the water supplier may waive the requirement for a backflow preventer at the service connection if all the following conditions are met:

- All components of the auxiliary water system, including pumps, pressure tanks and piping, are removed from the premises, which are defined as all buildings, dwellings, structures or areas with water supply plumbing connected to the public water system.
- The possibility of connecting the auxiliary water system to the water supply plumbing is determined by the water supplier to be extremely low.
- No other hazards exist.
- The customer enters into a contract with the water supplier, as described below.

The contract will require the customer:

- To understand the potential hazard of a cross-connection.
- To never create a cross-connection between the auxiliary water system and the public water system.
- To allow an inspector to survey their property for hazards as long as the contract is in effect.
- To face loss of service and other penalties if the contract is violated.

The water supplier must perform an annual inspection of the customer's contract-regulated property to verify the conditions have not changed, which would warrant installation of a backflow preventer. The water supplier must, by law, do everything reasonably possible to protect the water system from contamination.

Booster Pumps

What is the concern?

Booster pumps connected to plumbing systems or water mains can cause backsiphonage by reducing the water mains. The following requirements are in place to help prevent backsiphonage:

- Booster pumps, not used for fire suppression, must be equipped with a low suction cut-off switch that is tested and certified every year;
- Alternately, when a booster pump is necessary for one-, two- and three-family dwellings, it is preferred that the booster pump draw from a surge tank filled through an air gap; and
- Booster pumps, used in a fire suppression system, must be equipped with either a low suction throttling valve on the discharge side or be equipped with a variable speed suction limiting control system. Low-pressure cut-off devices will suffice for fire pumps installed prior to August 8, 2008, until a significant modification is warranted, at which point the minimum pressure sustaining method must be updated. Each of these methods must be tested and certified each year.

Contacts

Need more information?

Questions concerning backflow prevention and cross-connection control may be directed to your local water department or to your local Ohio EPA District Office at the following numbers:

Northwest District	**(419) 352-8461**
Northeast District	**(330) 963-1200**
Southwest District	**(937) 285-6357**
Southeast District	**(740) 385-8501**
Central District	**(614) 728-3778**

Questions regarding internal plumbing in the home may be directed to your local plumbing authority or to the Ohio Department of Commerce, Plumbing Administrator, at (614) 644-3153.

John Kasich, Governor
Craig W. Butler, Director

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Ohio Environmental Protection Agency

Backflow Prevention and Cross-Connection Control

Protecting our Public Water System

August 2015

Division of Drinking and Ground Waters
P.O. Box 1049
Columbus, Ohio 43216-1049
(614) 644-2752
www.epa.ohio.gov

What is a cross-connection?

Any physical connection created between a possible source of contamination and any drinking water system piping.

What is backflow?

It is the flow through a cross-connection from a possible source of contamination back into the drinking water system. It occurs when a cross-connection is created and a pressure reversal, either as backsiphonage or backpressure, occurs in the water supply piping.

Why be concerned?

- ALL cross-connections pose a potential health risk.
- Backflow can be a health hazard for your family or other consumers if contaminated water enters your water supply plumbing system and is used for drinking, cooking or bathing. Chemical burns, fires, explosions, poisonings, illness and death have all been caused by backflow through cross-connections.
- Backflow occurs more often than you think.
- You are legally responsible for protecting your water supply plumbing from backflow that may contaminate drinking water, either your own or someone else's. This includes complying with the plumbing code and not creating cross-connections.

What causes backsiphonage?

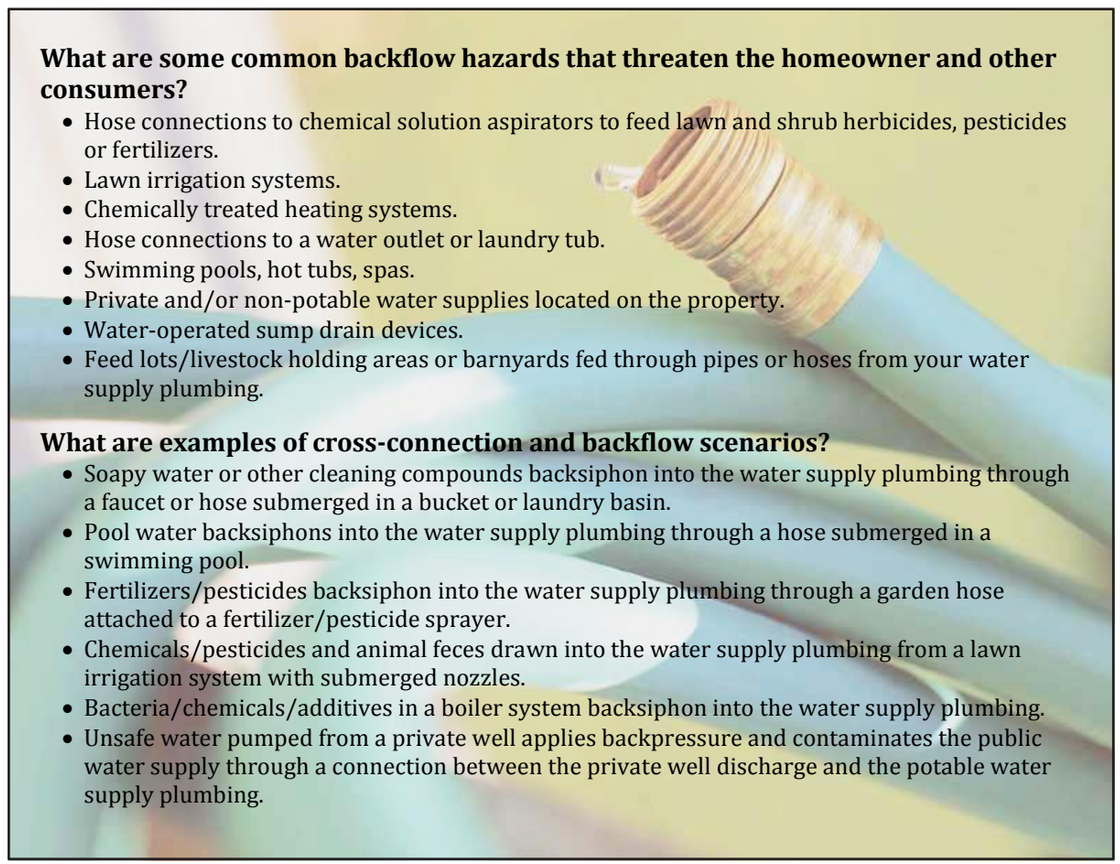
Backsiphonage occurs when there is a loss of pressure in a piping system. This can occur if the water supply pressure is lost or falls to a level lower than the source of contamination. This condition, which is similar to drinking from a glass with a straw, allows liquids to be siphoned back into the distribution system.

What causes backpressure?

Backpressure occurs when a higher opposing pressure is applied against the public water system's pressure. This condition allows undesirable gases or liquids from another system to enter the drinking water supply. Any pumping system (such as a well pump) or pressurized system (such as steam or hot water boilers) can exert backpressure when cross-connected with the public water system.

What can I do?

- Be aware of and eliminate cross-connections.
- Maintain air gaps. Do not submerge hoses or place them where they could become submerged.
- Use hose bib vacuum breakers on fixtures (hose connections in the basement, laundry room and outside).
- Install approved, testable backflow preventers on lawn irrigation systems.
- Do not create a connection between an auxiliary water system (well, cistern, body of water) and the water supply plumbing.



What are some common backflow hazards that threaten the homeowner and other consumers?

- Hose connections to chemical solution aspirators to feed lawn and shrub herbicides, pesticides or fertilizers.
- Lawn irrigation systems.
- Chemically treated heating systems.
- Hose connections to a water outlet or laundry tub.
- Swimming pools, hot tubs, spas.
- Private and/or non-potable water supplies located on the property.
- Water-operated sump drain devices.
- Feed lots/livestock holding areas or barnyards fed through pipes or hoses from your water supply plumbing.

What are examples of cross-connection and backflow scenarios?

- Soapy water or other cleaning compounds backsiphon into the water supply plumbing through a faucet or hose submerged in a bucket or laundry basin.
- Pool water backsiphons into the water supply plumbing through a hose submerged in a swimming pool.
- Fertilizers/pesticides backsiphon into the water supply plumbing through a garden hose attached to a fertilizer/pesticide sprayer.
- Chemicals/pesticides and animal feces drawn into the water supply plumbing from a lawn irrigation system with submerged nozzles.
- Bacteria/chemicals/additives in a boiler system backsiphon into the water supply plumbing.
- Unsafe water pumped from a private well applies backpressure and contaminates the public water supply through a connection between the private well discharge and the potable water supply plumbing.

What must be done to protect the public water system?

The public water supplier must determine potential and actual hazards. If a hazard exists at a customer's public water supply service connection, the customer will be required to install and maintain an appropriate backflow preventer* at the meter and/or at the source of the hazard.

*Check with your water supplier to verify which backflow preventer is required before purchase or installation.

Who is responsible?

In Ohio, the responsibility for preventing backflow is divided. In general, state and local plumbing inspectors have authority over plumbing systems within buildings while Ohio EPA and water suppliers regulate protection of the distribution system at each service connection.

Water customers have the ultimate responsibility for properly maintaining their plumbing systems. It is the homeowner's or other customer's responsibility to ensure that cross-connections are not created and that any required backflow preventers are tested yearly and are in operable condition.

What is the law?

Ohio Administrative Code Chapter 3745-95 requires the public water supplier to protect the public water system from cross-connections and prevent backflow situations. The public water supplier must conduct cross-connection control inspections of their water customers' property to evaluate hazards. Local ordinances or water department regulations may also exist and must be followed in addition to state regulations.

Ohio Environmental Protection Agency

District Offices

Central Office
Lazarus Government Center
50 W. Town St., Suite 700
P.O. Box 1049
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 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.