# Bulk Storage Tank System Design & Sizing

Overview

Monroe County Health Department receives proposals from property owners who wish to use a hauled water system (HWS) to provide potable water for single-family dwellings. These systems include a storage tank that is filled with water from a source located off of the premises. Water from this tank is then pumped into a pressure tank and into the home's distribution system. The reasons could be a public health concern (contaminants), poor aesthetic quality or insufficient quantity. If it is not possible to obtain an adequate amount of safe potable water from an on site source, or the well cannot meet peak water demands, then the design of a hauled water or pump and re-pump system may be the only acceptable alternatives.

There are a number of potential problems with these systems and their use should not be allowed if municipal water is available. Whether the system is hauled water or a re-pump system the cost for design and operation will be far greater than a conventional water supply system.

I. USES
   - A. Low capacity well storage and re-pump systems
   - B. Water treatment systems

II. GENERAL

*R 325.1008 of the Michigan Safe Drinking Water Act (MSDWA) states: "Design and operation standards of public water supplies; considerations." "The department shall give due consideration to the size, type, location, and other conditions at public water supplies for the purpose of specifying design and operation standards."*

Example -

The size and complexity of a water supply system is an important factor in allowing for possible approval of a hauled water or re-pump system. Designing and approving a re-pump system utilizing a 3 gallon per minute (gpm) well for a small water supply system requiring 18 gpm may be very attainable whereas attempting to use the same 3 gpm well to service a large 120 gpm supply is not reasonable.

*R 325.1013. Sec. 13. (2) of the MSDWA "The Department may promulgate rules setting standards of quality, composition, safety, or design of products. Until the department promulgates rules setting standards for products, all products that may come in contact with water intended for use in a public water supply shall meet American national standards institute / national sanitation foundation standards, specifically ANSI / NSF standard 60-1988 and ANSI / NSF standard 61-1988 which are hereby incorporated by reference. Adoption of a product standard by rule supercedes the standard incorporated by reference in this section."*

*R 325.1672 of the Groundwater Quality Control Rules states: "If a storage reservoir is used in a water supply system, plans for the storage reservoir installation shall be submitted to the health officer and approval obtained before installation of the reservoir. A storage reservoir shall be constructed of materials approved by the department and shall be designed, operated, and maintained to prevent the entrance of contaminants."*

Review of the submitted plans and specifications for the storage reservoir, piping and pumping components is done to determine suitability of proposed materials.

III. COMPONENTS

- A. Well and well pump, or a licensed water hauler
- B. Bulk storage tank.
- C. Water level sensing switches. Used where well is providing water to bulk storage tank. Switch turns well pump on and off as water level in bulk storage tank fluctuates.
- D. Fill pipe. Used in hauled water systems to transfer water from licensed water hauling truck to bulk storage tank.
- E. Vent pipe. Used to allow movement of air in and out of bulk storage tank as the water level in tank fluctuates, and to allow for the safe discharge of gases from water. Design will vary with type of system installed.
- F. Water pump. Pumps water from bulk storage tank to distribution system.
- G. Hydropneumatic tank.
- H. Standard pressure switch.

IV. BULK STORAGE TANK SIZE - Sizing depends on use of bulk storage tank system. The following are suggested sizing criteria for different types of systems.

- A. Hauled water systems. Size of bulk storage tank should be determined by:
  1. Use of hauled water system. Is hauled water system serving all water needs of the facility (toilet flushing, irrigation, laundry, sinks, showers, etc.), or is hauled water system used for potable water use only (sinks, showers, bathtub, ice makers, etc.)? A well with aesthetically objectionable water is sometimes used as the source of water for toilet flushing, irrigation, laundry, or other nonpotable uses, significantly reducing the amount of storage needed in hauled water portion of water supply system.
  2. Available space. Space for placement of bulk storage tanks, or access to tank placement locations, may be limited. This may result in the forced use of a smaller tank(s) with more frequent deliveries of water to tank(s). Space requirements should really only be an issue with existing noncommunity systems.
  3. Capacity of water hauling truck delivering water. If possible, bulk storage tank should have a capacity at least equal to, and preferably a little larger than, capacity of water hauling truck delivering water. This is an economic consideration, since the water hauler could deliver a full load of water at each delivery, and bulk storage tank would not need to be completely empty to accept that full load.

B. Low capacity well storage and re-pump systems. The following steps should be followed to determine size of storage bulk storage tank needed for a water supply using a low capacity well:

1. Determine peak water demand rate. This is the maximum rate in gallons per minute that water needs to be delivered to a facility's distribution system to meet water demand during its busiest time of day. For Noncommunity Public Water Supply systems use the "residential, fixture count and fixture method" to determine the peak demand needs.

   Example – Using the fixture count method at a tavern: sinks 4, water closets 4, urinals 2, utility sink 1, ice machine 1, service sink 1 and hose bibs 2 for a total of 15 fixtures. Peak demand table shows 1.3 gpm/fixture at mercantile buildings, therefore:

   15 fixtures x 1.3 gpm = 19.5 gpm (Rounded to 20 gpm)

2. Determine length of normal peak use period for facility. This is the time period each day when water is used at peak water demand rate for an extended period of time. In a tavern, the peak use period may be Saturday evening when toilets and urinals are being flushed at the same time. Duration of a normal peak use period ranges from 7 to 60 minutes, depending on popularity of facility and other water uses, e.g., small kitchen. In no case should a peak use period of less than 15 minutes be used when determining public water supply needed storage capacity.

   Example – The busiest time at the tavern is between 6:30 and 7:00 p.m. on Saturday evening. The normal peak use period is 60 minutes in length.

3. Determine total volume of water needed during peak use periods. Multiply peak water demand rate (gallons per minute) times normal peak use period (in minutes).

   Example - The tavern has a peak water demand rate of 20 gpm and a normal peak use period of 60 minutes. Total water volume needed during peak use period is:

   20 gpm x 60 minutes = 1200 gallons

4. Determine amount of water available from well/pump during peak use period by multiplying pump capacity by peak demand period.

   Example - The well at the tavern can produce only 2 gpm. During a 60-minute peak use period the well can produce 120 gallons (2 gpm x 60 minutes).



5. Determine volume of water that must be provided from storage by finding the difference between amount of water produced by well (#4 above)

during peak demand period and total volume of water needed during peak demand period (#3 above).

Example - For the tavern, 1200 gallons needed during each peak use period - 120 gallons provided from well = 1080 gallons needed in storage.

C. Water treatment systems - Purpose of bulk storage tank is twofold:

1. To provide a location for mixing of treatment chemicals (oxygen, chlorine, etc.) with water from well, including spray bar aeration and chemical injection by a chemical feed pump.

2. To provide for retention of treated water, allowing for desired release of gases (methane, H2S, etc.) for venting from tank, or for chemical changes to occur (H2S to sulfates, ferrous iron to ferric iron, etc.)

Bulk storage tank volume is determined by amount of time water from well needs to be retained in tank to complete water treatment process. Retention time will vary depending on type of treatment being employed. As a general rule of thumb, a bulk storage tank should have a minimum water capacity equal to 5 to 10 minutes at peak use rate.

Example - A tavern has a peak use rate of 20 gpm. Bulk storage tank should have a minimum water storage capacity equal to 20 gpm x 10 minutes = 200 gallons. This 200 gallons is available water storage. If aeration is the treatment method to be used, an air space must be provided in the tank, in addition to the 200 gallons of water storage, to allow for installation of a spray bar.

V. BULK STORAGE TANK MATERIALS

A. Most common types:

1. Polyethylene Plastic
   a. Must meet F.D.A. Regulation 21 CFR 177.1520 or ANSI/NSF Standard 61.
   b. Least expensive of tank materials.
   c. Corrosion proof.
   d. Easily cleanable because of smooth surface.
   e. Light weight. Easy to transport and handle.

2. Steel - several common types:
   a. Stainless steel - Resistant to corrosion, easy to clean.
   b. Galvanized steel - Resistant to corrosion, but not as much as stainless steel. Subject to scale formation on tank wall.
   c. Black steel - Subject to corrosion, difficult to clean because of rough surface. Subject to scale formation on tank wall. Generally needs to be coated with a protective surface, such as epoxy paint.



3. Fiberglass

B. Bulk storage tanks must be specifically designed for use as a water or food

product storage unit. Tanks previously used for other purposes, such as old fuel oil tanks, shall not be used for potable water storage.

VI. BULK STORAGE TANK COATINGS

A. Must meet ANSI/NSF Standard 61

VII. BULK STORAGE TANK ACCESSORIES

A. Vent - Required to prevent creation of a vacuum inside bulk storage tank as water level is lowered during usage. May also serve as a means to safely remove gases, such as methane and hydrogen sulfide, from bulk storage tank.

1. Screened
2. Downturned
3. May need to terminate outside of building to safely discharge vented combustible or toxic gases.

B. Manhole - Required in larger bulk storage tanks to provide access to interior of tank for cleaning and maintenance.

Manhole cover must be of sanitary design and overlapping.

C. Bottom Drain - Needed to allow emptying tank for cleaning and maintenance purposes.

D. Fill Pipes - Required for hauled water systems.
1. 3 inch to 4 inch diameter
2. Fill pipe cover (end cap)
   a. Recommend a locking type for security
   b. Secure Cap i.e. Well cap
   c. Self closing
   d. Weatherproof and sanitary

VIII. BULK STORAGE TANK LOCATION

A. Must be above grade or in an approved basement. Bulk storage tanks must not be buried. Tanks are not pressurized, and any leak in a tank would allow the entrance of contaminants from around tank.

B. Must be in an area not subject to freezing conditions.

C. Bulk storage tank location should be clean and dry.

D. Bulk storage tank should be located to allow accessibility to tank for cleaning, general maintenance, etc.



IX. PIPES AND FITTINGS - Must be approved material

A. Plastic - Generally, P.V.C. or P.E.

1. ANSI/NSF approved for potable water contact
2. 160 psi minimum

B. Copper

C. Galvanized

X. WATER PUMP

The pump drawing water from the bulk storage tank is generally a shallow well jet pump or a centrifugal pump. **Capacity of pump (its pumping rate) must be at least equal to peak demand rate (gpm) for facility being served.**

XI. HYDROPNEUMATIC PRESSURE TANK

A hydropneumatic pressure tank is installed downstream from water pump, and is sized, installed, and operated as in any conventional water supply system. The draw down capacity (not total capacity) must be equal to the pump capacity.