ITEM 1

WUNDERLICH SURVEYING & ENGINEERING, INC.
20 S. CHURCH STREET • P.O. BOX 536 • UNION, MO 63084
(636) 583-8400 Fax: (636) 583-1810

Report and Specifications

For
Proposed Public Well and Distribution System

To Serve

"Holtgrewe Farms"

Date
February 19, 2010

Owner
Holtgrewe Farms, LLC
109 North Oak St.
Union, MO 63084

Prepared By

Wunderlich Surveying & Engineering, Inc
20 South Church Street
Union, Missouri 63084

2.22.2010
Norbert Wunderlich, P.E.

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INTRODUCTION:

Holtgrewe Farms is a 47- lot subdivision located in Franklin County, Missouri. (SE ¼ and SW 1/4, Sec. 20, T44N, R1W, of the 5TH P.M.) Holtgrewe Farms, LLC is the developer for this subdivision. The sanitary sewage from Holtgrewe Farms will be collected by a gravity system and treated by an on site wastewater treatment facility.

Holtgrewe Farms is located within the PWSD #1 of Franklin County. However, PWSD #1 does not have sufficient service in this area, and upon initial contact, were not willing to extend services to the subdivision. When contacted about permission to construct a public water system within the district, PWSD #1 requested that the Missouri Department of Natural Resources contact them directly if a letter is required.

Holtgrewe Farms, LLC is proposing a centralized water distribution system to serve Holtgrewe Farms subdivision. The continuing authority will be Holtgrewe Farms Water Company LLC.

DESIGN & CALCULATIONS:

Proposed System:

The proposed system will consist of a ground water well, a 12,600 gallon ground water storage tank, a 7.5 hp booster pump, and a 1,078 gallon pressure tank operating through the 50/70 psi pressure range. The distribution piping will consist of approximately 3,840 lineal feet of 4-inch SDR 21 class 200 PVC pipe. **This system is not intended to provide fire flow**, therefore only flush hydrants will be provided at the end of the lines and at high points in the system to allow flushing of the lines when required.

Ground Water Well:

A request was made to Missouri Department of Natural Resources, Division of Geology and Land Survey concerning a casing depth letter for a community well. A copy of this letter has been included with this report. DNR~DGLS estimated the casing depth to be 350-feet below the existing ground elevation. It was recommended that a pilot hole be constructed to the total depth of the well. DNR~DGLS requires the well driller to send samples of the cuttings to their office to determine the exact casing depth for the proposed well.

At the total drill depth of 600 feet, the well should yield 90+ gallons per minute (gpm) of water. The proposed yield from the well will be 37 gpm. In the future a larger well pump can be added to increase the capacity of the well if required. The difference between the maximum hour demand and the proposed pumping rate will be absorbed by the ground water storage tank.

After consulting a local well driller, it was decided to use 6-inch well casing, with a 5-hp pump set at approximately 300-350-feet. This was based on the casing depth letter and the well driller's knowledge of other wells in this area. Based on other wells in the area, the well driller expects that the static water level will be about 250-feet down. Final depth of the well pump will be determined after the well shaft is drilled and a draw down test has been performed.

The discharge for the pump will be 2-inch in diameter. The discharge piping will have two inline check valves. The first valve will be spaced approximately 25-feet above the pump, and the second will be placed approximately 175-feet above the pump. The well discharge will connect to the well house piping just above the sanitary split ring seal, and it will terminate with a 2-inch tee connection. The run of the tee shall be plugged. The 1.5-inch diameter screened vent pipe and the electrical connection for the submersible motor can enter through the side of the well casing or through the top of the sanitary split ring seal. The sanitary split ring seal will require a depth gauge.

Well House:

The well will discharge into a 12,600-gallon surface storage tank. This tank was sized assuming 47 homes with 3.5 persons per home at average daily flow of 100 gallons per person per day. Holtgrewe Farms currently has 47 residential building lots. According to the Design Guide for Community Water Systems, the maximum hourly demand is $12(\#\text{ of homes})^{0.515}$. The maximum hourly demand is 87 gpm. The estimated yield for the well pump is ±37 gpm for a pump depth and static water level of 300-feet.

The surface ground storage tank will be 12-foot in diameter and a total of 15-feet tall. The tank will be equipped with both exterior and interior ladders for access. The ground storage tank will have 2-24-inch diameter man accesses. A 4-inch diameter overflow pipe shall be attached to the tank and be equipped with a flap valve on the end of the screened pipe. A screened 4-inch vent shall be supplied on the top of the tank, and a 4-inch drain plug shall be located at the bottom of the tank. A 2-inch inlet line shall be run into the tank as shown on the plans. A 3-inch outlet pipe will discharge from the tank as shown on the plans. The elevation of the water in the tank will be controlled with an Ametek black/white level controller. The controller will cycle the well through the on/off cycles. The tank will be provided with 2-feet of drawdown under normal conditions. The ground storage tank will have a total drawdown of 4.24-feet during the maximum hour event. It will take the well pump 2.34 hours to fill the ground storage tank.

A 7.5-hp booster pump will be connected to the 3-inch discharge line from the ground storage tank. The booster pump shall be capable of providing 87 gallons per minute of flow at 70 psi. This flow is greater than the max. hour demand which is 68.5 gallons per minute. The flow from the booster pump will discharge into the pressure tank. The control for the booster pump will be a Square D pressure switch set for the 50/70 psi range.

The pressure tank was sized assuming two minutes of flow from the largest supplying pump. In this case the booster pump at 87 gpm will require 174 gallons of available storage. Using the charts provided in the draft guidelines provided by Mo~DNR, a 1,078 gallon pressure tank will be required. The supplied chart yielded the usable volume of the tank at 192.4 gallons, the water seal at 359.3 gallons and the air cushion at 526.3 gallons.

An oil-less air compressor will control the air cushion. This compressor is designed for use on hydro-pneumatic pressure tanks. This air compressor will provide the make up air that will be absorbed in the water of the pressure tank. The pressure tank will be equipped with an 80 psi

pressure release valve. The pressure vessel shall meet ASME boiler codes, NSF Standard 61, and AWWA D100 guidelines

The well house will be standard wood frame construction. The interior of the well house will be sheeted with 1/2–inch treated plywood. The plywood shall be painted to owner choice of color. 4-inch floor drains will be provided incase of a leak. A 4-kw wall mounted heater will be provided for heat during the winter months. Chlorine disinfection is not intended at this time. A room will be constructed to house the chlorine equipment if it becomes necessary to disinfect in the future.

Distribution System:

The distribution system shall consist of 4-inch SDR 35 Class 200 PVC pipe. Because the pressure tank will be operating through the 50-70 psi pressure range, the distribution system should not be below 35 psi at any part of the proposed system. At the lowest point in the proposed distribution system the high pressure will be approximately 95 psi. The homes built in these areas will require a pressure reducing valve located inside the home.

The distribution system was analyzed assuming the equation $Q = 12(N)^{0.515}$ where N is the number of connections drawing on the line. WaterCAD, a program developed by Haestad Methods, was used to perform the calculations. This program employs the Hazen-Williams Method to determine the flow through the pipes. These calculations have been included showing the calculated flows, pipe head losses, and node pressures for the system at the 50, 60, and 70 psi pressure ranges.

References:

Design Guide for Community Public Water Supplies, August 2003, MO-DNR

Master Level Controls Company

WaterCAD, by Haestad Methods, Water distribution Analysis Program

Masterspec, by Arcom,, specification program

Special Thanks to

Wideman Well Drilling, Inc.

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STATE OF MISSOURI
Jeremiah W. (Jay) Nixon, Governor • Mark N. Templeton, Director
DEPARTMENT OF NATURAL RESOURCES
www.dnr.mo.gov

September 21, 2009

Mr. Ron DeClue
Wunderlich Surveying and Engineering, Inc.
20 South Church Street
Union, MO 63084

Franklin County
NE ¼, SE ¼, SE ¼, Sec. 20, T. 44 N., R. 1 W.
Holtgrewe Farms, LLC, Subdivision
Community Public Water Supply Well

Dear Mr. DeClue:

This letter is in response to your request for information concerning a community public water-supply well to serve a 47 unit subdivision at the above location in Franklin County.

The casing depth and total depth estimates provided in this letter are for informational purposes only. This letter is not to be considered an approval to construct the well. This information is intended to be used for developing engineering plans and for financial planning purposes. Actual construction of the well or any regulated part of the water system must not begin until the engineering plans have been reviewed and approved by the Water Protection Program, Public Drinking Water Branch, and a construction permit has been issued.

Since this well is to be a public water-supply well, construction of the well must conform to the standards of the Department of Natural Resources, Division of Environmental Quality as outlined in their publication **DESIGN GUIDE FOR COMMUNITY WATER SYSTEMS** (Effective August 29, 2003). These standards are necessary for facilities to comply with sections 640.100-640.155 of the Revised Statues of Missouri and 10 CSR 60-1 through 10 CSR 60-10 of the Missouri Code of State Regulations.

One of the requirements of the Department of Natural Resources is that a registered professional engineer must prepare plans and specifications for public water supply projects. The completed plans are to be submitted to the Water Protection Program, Public Drinking Water Branch, for their review and approval before the start of construction. If the completed project does not conform to the published standards, a permit to dispense water to the public cannot be issued. Copies of the regulations and design standards are available upon request from the Water Protection Program, Drinking Water Branch, Department of Natural Resources, Division of Environmental Quality, P.O. Box 176, Jefferson City, MO 65102.

One other requirement for a community water supply is that this office determines the well casing depth. The required casing depth for a well at this location is estimated to be 350 feet, into the upper Roubidoux Formation. This is based on a surface elevation of 600 feet above sea level. To assist in establishing a final approved casing depth, rock cuttings must be submitted to the total depth of the well. It could be advantageous to have a "pilot hole" drilled to total depth before casing is set and grouted. Doing so would minimize the possibilities of

encountering drilling problems below the casing depth that could jeopardize the successful completion of the well.

The casing must meet or exceed the standards contained in Section 3.2.5.6 (page 36) and Figure 3 (page 45) of the **DESIGN GUIDE FOR COMMUNITY WATER SYSTEMS**. The casing must be installed in a drill hole that is a nominal four (4) inches larger in diameter than the casing, and then pressure grouted using neat cement grout. The grout placement (Positive-Placement Interior Method) must meet the standards set forth in Section 3.2.5.11 (pages 38-40) of the aforementioned design guide. Once the grouting is complete, operations must be suspended for a minimum period of seventy-two (72) hours. Pressure grouting of the casing is to be witnessed by DNR regional office personnel in St. Louis (314-416-2960; please give 48 hours notice of intent to grout.)

A total drilled depth of 600 feet, into the lower Gasconade Dolomite, should provide a yield of 90 gallons per minute. Higher yields are available at greater depths. If an adequate yield is obtained at a somewhat shallower depth, then the total depth of the well can be adjusted accordingly.

According to our records the proposed well site is within the district boundaries of Franklin County PWSD #1. There are State laws and regulations that pertain to developing new public water supplies within existing public water supply district boundaries. I encourage you to contact the Public Drinking Water Branch at the department's St. Louis Regional Office (314-416-2960) to discuss this matter further.

If I can help further, please feel free to contact me at 573-368-2194.

Sincerely,

WATER RESOURCES CENTER

James E. Vandike, R. G.
Groundwater Section Chief
(573-368-2175)

cc: Holtgrewe Farms, LLC, Union
Ms. Bev Elya, Water Protection Program, Public Drinking Water, Jefferson City
DNR-St. Louis Regional Office

Project: Holtgrewe Farms
Project No: 5181

A.) Design Water Demand

1.) Population to be served. Homes to be served $home := 47$ Section 1.1.2.d.3 of the Design Guide

Persons per home $capita := 3.5$

Total estimated population to be served. $dd := capita \cdot home$ $dd = 165$ People

2.) Average Daily Demand per person $ADD := 100 \cdot \frac{gal}{day}$ Section 1.1.2.d.3 of the Design Guide

Design flow $Df := ADD \cdot dd$ $Df = 16450 \frac{gal}{day}$ or $Df = 11.42 \frac{gal}{min}$

Peak Hourly Flow using equation from section 1.1.2.f.3 from the Design Guide for Community Water Systems.

$Q := 12 \cdot home^{0.515}$ $Q = 87.16$ gallons per minute

3.) Maximum hourly demand $Mh := 6 \cdot Df$ $Mh = 68.54 \frac{gal}{min}$

Proposed pump has to have a source capacity that meets or exceeds the design maximum day demand(section 3.2.1.1of the design guide). The definitions on page i define the maximum day demand as 150% of the average day demand.

Pump minimum flow $PMF := 1.5 \cdot Df$ $PMF = 17.14 \frac{gal}{min}$

At an assumed pump depth of 300 ft the proposed pump yields 37 gpm at 30 psi

4.) Flow demand in distribution pipes was estimated using the Q=12home^0.515 equation throughout the distribution system. The demand on each line was analyzed using WaterCAD, a computer program produced by Haestad Methods. This program determines the flow throughout the individual legs of the distribution system. Copies of the results for the water system high, middle, and low pressure scenarios have been included.

B.) Proposed Well Capacity

The preliminary casing letter was received from Mo~Dnr. This letter stated that the estimated casing depth was 350 feet based on a surface elevation of 600 feet. The estimated total drill depth for the well is 600 feet, and the approximate well yield will be 90+ gallons per minute. This should be greater than the maximum hourly demand. The assumed elevation of the pump will be 350 feet.

C.) Above Ground Storage

A Community Public water supply serving more than 50 connections shall have storage in addition to a hydro-pneumatic tank(Section 7.4.1 of the Design Guide). This system shall supply a storage capacity equal to or greater than one days average demand(Section 7.1.2 of the design guide). A hydro-pneumatic tank will provide pressure to the system. This system only has 47 connections, therefore additional storage is not required, however, 18 hours(77% of 24 hours) of additional storage will be supplied.

Average Daily Demand will equal the design flow $Df = 16450 \frac{gal}{day}$

Ground Storage Tank Volume $GST := 0.77 \cdot Df \cdot day$ $GST = 12666.5\,gal$

Assume Circular tank

Assumed height of tank $Ht := 15 \cdot ft$

Calculated area of tank $At := \frac{GST}{Ht}$ $At = 112.88\,ft^2$

Calculated Diameter of the Tank $Dia := \sqrt{\frac{At \cdot 4}{\pi}}$ $Dia = 11.99\,ft$

The Design Guide section 7.0.2.c requires a minimum 25% daily turnover in the tank

Maximum Ground Storage Tank Volume $GSTmax := 4 \cdot Df \cdot day$ $GSTmax = 65800\,gal$

D.) Hydro-Pneumatic Tank

A proposed 1078 gallons pressure vessel will be used to provide the pressure for the distribution system.

Calculated usable volume at the 40/60 psi range. Calculations based on table provided in Figure 4, page 144 of the Mo~DNR Design Guide for Community Water Systems.

Pressure Vessel Gross Volume $Gv := 1078 \cdot gal$

Usable Volume	$UV := 17.85 \cdot \%\cdot Gv$	$UV = 192.42\,gal$
Water Seal	$Ws := 33.33 \cdot \%\cdot Gv$	$Ws = 359.3\,gal$
Air Cushion	$AC := 48.82 \cdot \%\cdot Gv$	$AC = 526.28\,gal$

Assuming the Booster Pump will provide a flow of 90 gpm at 161.7 feet (70 psi) of total head the pressure tank is required to have two minutes of discharge at the 90 gpm pumping rate (7.4.5 of the Design Guide).

Required Usable Volume	$RUV := 2 \cdot min \cdot 87 \cdot \frac{gal}{min}$	$RUV = 174\,gal$
Usable Volume Supplied	$UVS := UV$	$UV = 192.42\,gal$

E.) Ground Storage Tank Flow Levels at Average Daily Flow

Diameter of Tank $D := 12 \cdot ft$

Area of Tank $AT := \frac{\pi}{4} \cdot D^2$

Volume of the tank per foot of Depth $VT := AT \cdot 1 \cdot ft$ $VT = 846.03\,gal$

Allowing the tank to have a 2 foot draw down yields a flow to the subdivision as follows

Distance between pump on and pump off probes $H := 2 \cdot ft$

Volume of water to subdivision before pump starts $VW := AT \cdot H$ $VW = 1692.05\,gal$

Time between pump starts at average daily demand flow $Addps := \frac{VW}{Df}$ $Addps = 2.47\,hr$

Assumed flow from the well pump $WPR := 37 \cdot \frac{gal}{min}$

Time required to fill the tank between pump on and pump off $TF := \frac{VW}{WPR - Df}$ $TF = 66.16\,min$

F.) Ground Storage Tank Levels at Max.Hour Demand

Max. Hour Demand $Mh = 68.54 \frac{gal}{min}$

Time to turn pumps on if tank is full. $TPO := \frac{VW}{Mh}$ $TPO = 24.69\,min$

Time Remaining in Max Hour Flow. $Tr := 1 \cdot hr - TPO$ $Tr = 35.31\,min$

Fill rate for the remaining time after the well pump has started $Dr := Mh - WPR$

if the value is negative then the tank is being filled. $Dr = 31.54 \frac{gal}{min}$

Drawdown Depth for the remainder of the max hour. $DD := \frac{Dr \cdot Tr}{AT}$ $DD = 1.32\,ft$

if the value is negative then the tank is being filled.

Total Drawdown in the tank if max hour occurs when tank is full $TDD := DD + H$

$TDD = 3.32\,ft$

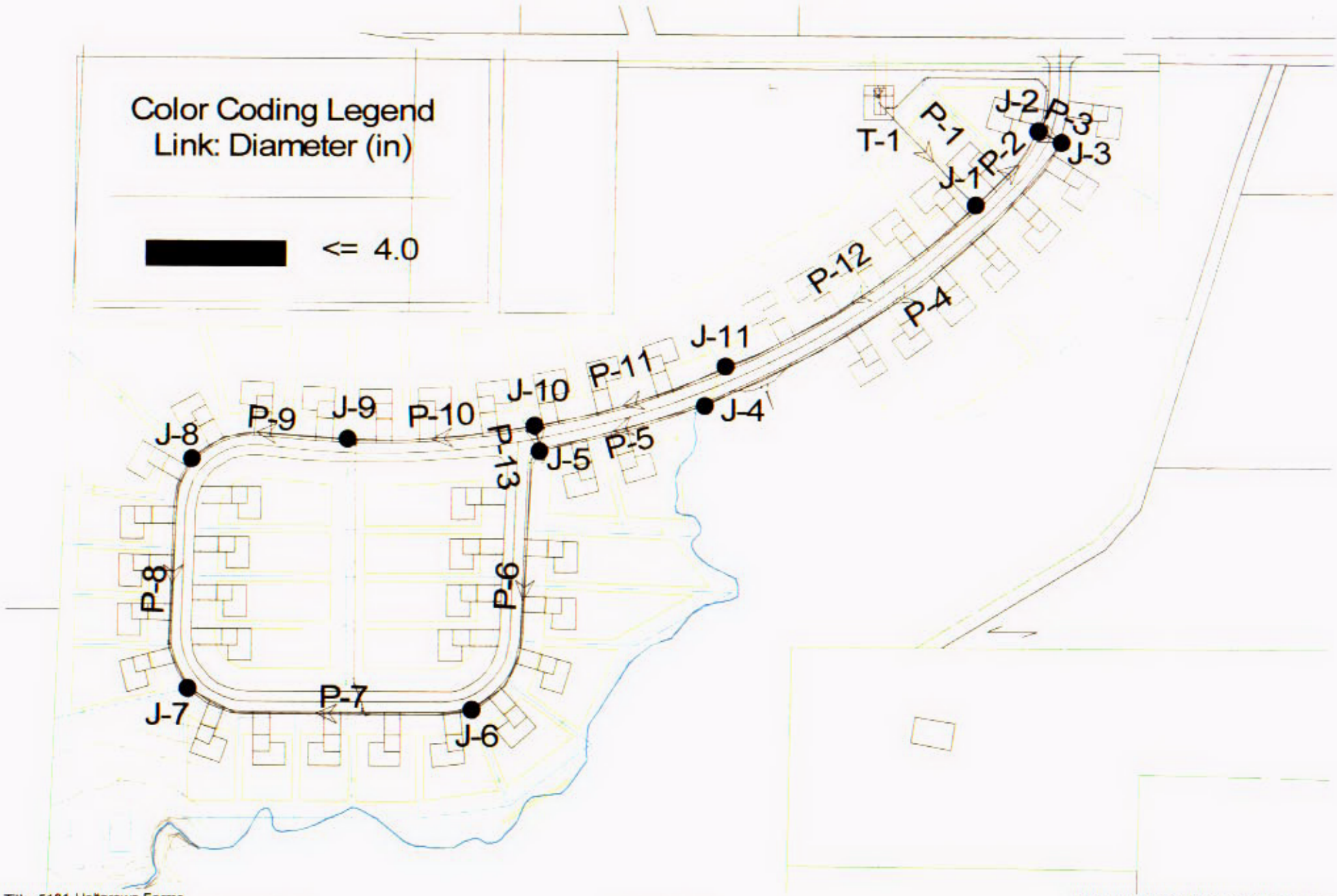
Assuming the max hour occurs when the well pump turns on

Total Drawdown Depth $Tdd := \left(\frac{Dr \cdot 1 \cdot hr}{AT}\right) + H$ $Tdd = 4.24\,ft$

Time Required to fill the Tank from this level $TF := \frac{Tdd \cdot AT}{(WPR - Df)}$ $TF = 140.15\,min$

Therefore if the well pump is ready to engage when the maximum hour flow occurs the ground storage tank will see a total 4.24 foot drop in the water level of the tank and it will take 140.15 minutes to fill the tank to shut off level assuming average daily demand on the system while filling.

Scenario: High Pressure (70 psi in tank)



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Project Engineer: NE Computer System
WaterCAD v4.5 [4.5015b]

Scenario: Low Pressure (50 psi in tank)
Steady State Analysis
Junction Report

Label	Elevation (ft)	Zone	Type	Demand (gpm)	Pattern	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-1	607.00	Zone-1	Demand	5.60	Fixed	5.60	716.45	47.36
J-2	618.00	Zone-1	Demand	1.90	Fixed	1.90	716.29	42.53
J-3	613.00	Zone-1	Demand	7.40	Fixed	7.40	716.25	44.67
J-4	556.00	Zone-1	Demand	7.40	Fixed	7.40	715.82	69.14
J-5	566.00	Zone-1	Demand	7.40	Fixed	7.40	715.71	64.77
J-6	543.00	Zone-1	Demand	13.00	Fixed	13.00	715.58	74.67
J-7	542.00	Zone-1	Demand	13.00	Fixed	13.00	715.56	75.09
J-8	565.00	Zone-1	Demand	11.10	Fixed	11.10	715.57	65.14
J-9	575.00	Zone-1	Demand	5.60	Fixed	5.60	715.62	60.84
J-10	570.00	Zone-1	Demand	5.60	Fixed	5.60	715.71	63.04
J-11	556.00	Zone-1	Demand	9.20	Fixed	9.20	715.94	69.20

Scenario: Low Pressure (50 psi in tank)
Steady State Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Check Valve?	Minor Loss Coefficient	Control Status	Discharge (gpm)	Upstream Structure Hydraulic Grade (ft)	Downstream Structure Hydraulic Grade (ft)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)
P-1	214.00	4.0	PVC	150.0	false	1.14	Open	87.20	717.50	716.45	1.05	4.88
P-2	145.00	4.0	PVC	150.0	false	0.59	Open	39.90	716.45	716.29	0.16	1.12
P-3	39.00	4.0	PVC	150.0	false	0.55	Open	38.00	716.29	716.25	0.05	1.17
P-4	670.00	4.0	PVC	150.0	false	0.00	Open	30.60	716.25	715.82	0.43	0.64
P-5	258.00	4.0	PVC	150.0	false	0.74	Open	23.20	715.82	715.71	0.10	0.40
P-6	423.00	4.0	PVC	150.0	false	0.60	Open	20.70	715.71	715.58	0.13	0.32
P-7	433.00	4.0	PVC	150.0	false	0.40	Open	7.70	715.58	715.56	0.02	0.05
P-8	359.00	4.0	PVC	150.0	false	0.79	Open	5.30	715.57	715.56	0.01	0.03
P-9	245.00	4.0	PVC	150.0	false	0.40	Open	16.40	715.62	715.57	0.05	0.21
P-10	279.00	4.0	PVC	150.0	false	0.00	Open	22.00	715.71	715.62	0.10	0.35
P-11	301.00	4.0	PVC	150.0	false	0.74	Open	32.50	715.94	715.71	0.22	0.75
P-13	41.00	4.0	PVC	150.0	false	0.00	Open	4.90	715.71	715.71	8.54e-4	0.02
P-12	447.00	4.0	PVC	150.0	false	0.39	Open	41.70	716.45	715.94	0.52	1.16

Scenario: Mid Pressure (60 psi in tank)
Steady State Analysis
Junction Report

Label	Elevation (ft)	Zone	Type	Demand (gpm)	Pattern	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-1	607.00	Zone-1	Demand	5.60	Fixed	5.60	739.55	57.35
J-2	618.00	Zone-1	Demand	1.90	Fixed	1.90	739.39	52.52
J-3	613.00	Zone-1	Demand	7.40	Fixed	7.40	739.35	54.66
J-4	556.00	Zone-1	Demand	7.40	Fixed	7.40	738.92	79.14
J-5	566.00	Zone-1	Demand	7.40	Fixed	7.40	738.81	74.77
J-6	543.00	Zone-1	Demand	13.00	Fixed	13.00	738.68	84.66
J-7	542.00	Zone-1	Demand	13.00	Fixed	13.00	738.66	85.08
J-8	565.00	Zone-1	Demand	11.10	Fixed	11.10	738.67	75.14
J-9	575.00	Zone-1	Demand	5.60	Fixed	5.60	738.72	70.83
J-10	570.00	Zone-1	Demand	5.60	Fixed	5.60	738.81	73.04
J-11	556.00	Zone-1	Demand	9.20	Fixed	9.20	739.04	79.19

Scenario: Mid Pressure (60 psi in tank)
Steady State Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Check Valve?	Minor Loss Coefficient	Control Status	Discharge (gpm)	Upstream Structure Hydraulic Grade (ft)	Downstream Structure Hydraulic Grade (ft)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)
P-1	214.00	4.0	PVC	150.0	false	1.14	Open	87.20	740.60	739.55	1.05	4.88
P-2	145.00	4.0	PVC	150.0	false	0.59	Open	39.90	739.55	739.39	0.16	1.12
P-3	39.00	4.0	PVC	150.0	false	0.55	Open	38.00	739.39	739.35	0.05	1.17
P-4	670.00	4.0	PVC	150.0	false	0.00	Open	30.60	739.35	738.92	0.43	0.64
P-5	258.00	4.0	PVC	150.0	false	0.74	Open	23.20	738.92	738.81	0.10	0.40
P-6	423.00	4.0	PVC	150.0	false	0.60	Open	20.70	738.81	738.68	0.13	0.32
P-7	433.00	4.0	PVC	150.0	false	0.40	Open	7.70	738.68	738.66	0.02	0.05
P-8	359.00	4.0	PVC	150.0	false	0.79	Open	5.30	738.67	738.66	0.01	0.03
P-9	245.00	4.0	PVC	150.0	false	0.40	Open	16.40	738.72	738.67	0.05	0.21
P-10	279.00	4.0	PVC	150.0	false	0.00	Open	22.00	738.81	738.72	0.10	0.35
P-11	301.00	4.0	PVC	150.0	false	0.74	Open	32.50	739.04	738.81	0.22	0.75
P-13	41.00	4.0	PVC	150.0	false	0.00	Open	4.90	738.81	738.81	8.54e-4	0.02
P-12	447.00	4.0	PVC	150.0	false	0.39	Open	41.70	739.55	739.04	0.52	1.16

Scenario: High Pressure (70 psi in tank)
Steady State Analysis
Junction Report

Label	Elevation (ft)	Zone	Type	Demand (gpm)	Pattern	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-1	607.00	Zone-1	Demand	5.60	Fixed	5.60	762.65	67.34
J-2	618.00	Zone-1	Demand	1.90	Fixed	1.90	762.49	62.52
J-3	613.00	Zone-1	Demand	7.40	Fixed	7.40	762.45	64.66
J-4	556.00	Zone-1	Demand	7.40	Fixed	7.40	762.02	89.13
J-5	566.00	Zone-1	Demand	7.40	Fixed	7.40	761.91	84.76
J-6	543.00	Zone-1	Demand	13.00	Fixed	13.00	761.78	94.65
J-7	542.00	Zone-1	Demand	13.00	Fixed	13.00	761.76	95.08
J-8	565.00	Zone-1	Demand	11.10	Fixed	11.10	761.77	85.13
J-9	575.00	Zone-1	Demand	5.60	Fixed	5.60	761.82	80.83
J-10	570.00	Zone-1	Demand	5.60	Fixed	5.60	761.91	83.03
J-11	556.00	Zone-1	Demand	9.20	Fixed	9.20	762.14	89.19

Scenario: High Pressure (70 psi in tank)
Steady State Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Check Valve?	Minor Loss Coefficient	Control Status	Discharge (gpm)	Upstream Structure Hydraulic Grade (ft)	Downstream Structure Hydraulic Grade (ft)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)
P-1	214.00	4.0	PVC	150.0	false	1.14	Open	87.20	763.70	762.65	1.05	4.88
P-2	145.00	4.0	PVC	150.0	false	0.59	Open	39.90	762.65	762.49	0.16	1.12
P-3	39.00	4.0	PVC	150.0	false	0.55	Open	38.00	762.49	762.45	0.05	1.17
P-4	670.00	4.0	PVC	150.0	false	0.00	Open	30.60	762.45	762.02	0.43	0.64
P-5	258.00	4.0	PVC	150.0	false	0.74	Open	23.20	762.02	761.91	0.10	0.40
P-6	423.00	4.0	PVC	150.0	false	0.60	Open	20.70	761.91	761.78	0.13	0.32
P-7	433.00	4.0	PVC	150.0	false	0.40	Open	7.70	761.78	761.76	0.02	0.05
P-8	359.00	4.0	PVC	150.0	false	0.79	Open	5.30	761.77	761.76	0.01	0.03
P-9	245.00	4.0	PVC	150.0	false	0.40	Open	16.40	761.82	761.77	0.05	0.21
P-10	279.00	4.0	PVC	150.0	false	0.00	Open	22.00	761.91	761.82	0.10	0.35
P-11	301.00	4.0	PVC	150.0	false	0.74	Open	32.50	762.14	761.91	0.22	0.75
P-13	41.00	4.0	PVC	150.0	false	0.00	Open	4.90	761.91	761.91	8.54e-4	0.02
P-12	447.00	4.0	PVC	150.0	false	0.39	Open	41.70	762.65	762.14	0.52	1.16

SECTION 2511 - MUNICIPAL WATER DISTRIBUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Water Service Mains
   2. Water Main Appurtenances
   3. Fire and Flush hydrants

B. Related Sections include the following:
   1. Division 1 Specifications

C. Alternates: Refer to Division 1 Section "Alternates" for description of Work in this Section affected by alternates.

1.3 UNIT PRICES

A. Bid Unit Prices shall be used for final payment based on installed field measurements.

1.4 DEFINITIONS

A. AWWA; American Water Works Association
B. Continuing Authority; City, Municipality, or Home Owners Association where the work is being performed. Are responsible to Mo~DNR for the Ownership of the System.
C. Mo~DNR; Missouri Department of Natural Resources

1.5 DELIVERY, STORAGE, AND HANDLING

A. Contractor is responsible for the delivery, storage, and handling of all materials. Any expense incurred due to materials being damaged, lost, or stolen shall be the responsibility of the contractor.

1.6 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing weather conditions permit trench excavation to be performed according to manufacturers' written instructions and warranty requirements.

B. Field Measurements: Indicate measurements on Shop Drawings. When required by the Continuing Authority AS-Built drawings shall be provided at the expense of the owner.

1.7 COORDINATION

A. Contractor shall coordinate his/her work with the schedule prepared by the owner. The Contractor shall not perform work prior to its scheduled start date.

1.8 WARRANTY

A. Special Warranty: The contractor agrees to repair or replace components of the water distribution system that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Failed hydrostatic pressure testing.
      b. Burst pipe
      c. Faulty appurtenances

B. Warranty Period: 1 year from date of Substantial Completion.

1.9 EXTRA MATERIALS

A. Furnish extra materials described below.
   1. All equipment necessary to perform the required hydrostatic pressure test according to AWWA & Mo~DNR guidelines.
   2. All equipment necessary to disinfect the water line according to AWWA & Mo~DNR guidelines.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Pipe
   1. PVC
      a. Class 200 PVC water mains shall conform to ASTM D2241 and shall be pressure rated at 200 psi at 738 F with a standard dimension ratio of SDR 21. PVC pipe must be certified by the National Sanitation Foundation. Joints shall be integral bell push on joints with a single rubber gasket, making a pressure tight seal
      b. C900 PVC water mains shall conform to ANSI/AWWA C-900 DR-18 Class 150 requirements. PVC pipe must be certified by the National Sanitation Foundation.

Joints shall be integral bell push on joints with a single rubber gasket, making a pressure tight seal.

c. Fittings for PVC Mains, flanged and/or mechanical joint, shall be cast iron fittings for PVC pipe and shall meet the latest revisions of ANSIA21.11/AWWA C111. Fittings shall include all appropriate transition gaskets. All mechanical joints shall be restrained with "Mega Lug" restraining glands as manufactured by EBBA Iron Company or approved substitute.

2. Ductile Iron
   a. Ductile Iron Pipe used for water mains shall be cement lined super bell-tite push on joint. The pipe shall meet the requirements of the latest revision of ANSI A21.51/AWWA C151 for Class 50 ductile iron pipe. The pipe shall have a working pressure of 350 psi.
3. Valves
   a. Valves for PVC water lines shall be Mueller Model A-2360-20 gate valve, non-rising stem, resilient wedge, gate valve or approved substitute. Each valve shall include all appropriate transition gaskets. All mechanical joints shall be restrained with "Mega Lug" restraining glands as manufactured by EBBA Iron or approved substitute. All valves shall be sized according to approved drawings and shall meet AWWA C-509.
   b. Valves for Ductile Iron water lines shall be Mueller Model A-2360-20 gate valves, non-rising stem, resilient wedge gate valve. All valves shall have the required joint accessories. All valves shall be sized according to approved drawings and shall meet AWWA C509.
4. Gate Boxes
   a. Valve boxes shall be Mueller Model H-10360 with lid as manufactured by Mueller Company or approved substitute.
5. Tees & Bends
   a. All tees and bends shall meet AWWA C153/A21.53 and ANSI/AWWA C111/A21.11 requirements. All tees and bends shall be cement lined according to ANSI/AWWA C104/A21.4. Fitting size and joint type to match drawings. If joint type is not noted contact the Continuing Authority for preferred type of joint. If mechanical joints are used, all joints shall be restrained with a restraining gland. Mega Lug as manufactured by EBBA Iron or approved substitute.
6. Tapping Sleeve
   a. Tapping Sleeves for PVC water lines shall be Mueller Model H304, stainless steel with flanged outlet as manufactured by Mueller Company or approved substitute.
   b. Tapping valve shall be Mueller Model T-2360-16, gate valve non-rising stem, resilient wedge seat meeting AWWA C-509. All tapping valves shall include the required transition glands and shall be sized as shown on the drawings. All mechanical joints shall be restrained with "Mega Lug" restraining glands as manufactured by EBBA Iron or approved substitute.
7. Detectable Locator Tape
   a. Detectable locator tape shall be 3-inches wide, bonded layer plastic with magnetic foil core. Tape shall be labeled as follows "Caution: Water Main Buried Below".
8. Water Main Locator Wire
   a. Water main locator wire shall be # 12 copper wire, solid or stranded, insulated for 600 volts with splice points in valve boxes only.

C. Fire & Flush Hydrants
   1. Three-way Fire Hydrants

a. Three-way Fire hydrants shall comply with American Water Works Association specifications C502. Hydrants shall have: post type dry barrel design, two-piece standpipe; compression type main valve; five and one-forth (5 ¼) inch valve opening; two (2) two and one-half (2 ½) inch hose nozzles; one (1) four and one-half (4 ½) inch pumper nozzle; mechanical joint inlet with cast iron retainer glands; 7/8 inch square operating nut to open counter clockwise. Cast iron fitting shall be cement mortar lined with bituminous seal coat inside and out. Inlet connection shall be 6-inch mechanical joint. Fire hydrants shall be Model 423 as manufactured by the Mueller Company, or approved equal. Said hydrants shall be equipped with auxiliary gate valve and valve box and Mueller transition gland. Hydrants shall be properly restrained with tie rods or duc-lugs, size and quantity per manufactures recommendations for the hydrants pressure.

2. Two-way Fire Hydrant
   a. Two-way Fire hydrants shall comply with American Water Works Association specifications C502. Hydrants shall have: post type dry barrel design, two-piece standpipe; compression type main valve; five and one-forth (5 ¼) inch valve opening; two (2) two and one-half (2 ½) inch hose nozzles; mechanical joint inlet with cast iron retainer glands; 7/8 inch square operating nut to open counter clockwise. Cast iron fitting shall be cement mortar lined with bituminous seal coat inside and out. Inlet connection shall be 6-inch mechanical joint. Fire hydrants shall be Model 423 as manufactured by the Mueller Company, or approved equal. Said hydrants shall be equipped with auxiliary gate valve and valve box and Mueller transition gland. Hydrants shall be properly restrained with tie rods or duc-lugs, size and quantity per manufactures recommendations for the hydrants pressure.
3. Flush Hydrant
   a. One-way Flush hydrants shall comply with American Water Works Association specifications C502. Hydrants shall have: post type dry barrel design, two-piece standpipe; compression type main valve; 2 1/8-inch valve opening; one 2 ½ inch hose nozzles; mechanical joint inlet with cast iron retainer glands; 7/8 inch square operating nut to open counter clockwise. Cast iron fitting shall be cement mortar lined with bituminous seal coat inside and out. Inlet connection shall be 6-inch mechanical joint. Fire hydrants shall be Model 85 as manufactured by the Kupferle Foundry or approved substitute. Said hydrants shall be equipped with auxiliary gate valve and valve box and Mueller transition gland. Hydrants shall be properly restrained with tie rods or duc-lugs, size and quantity per manufactures recommendations for the hydrants pressure.

D. Water Service Connections
   1. Service Saddles
      a. Service saddles for water lines shall be Mueller Bronxe H-1300 Series or approved Substitute by the Continuing Authority. Saddles shall have a tapped outlet and shall be sized as specified by the Continuing Authority.
   2. Corporation Stops
      a. Corporation stops shall be Mueller B-25008 or approved substitute by the Continuing Authority. Corporation stops shall be sized by the Continuing Authority.
   3. Curb Valves and Valve Boxes
      a. Curb Valves for service connections shall be Mueller H-15209 or approved substitute by the Continuing Authority. Curb Valves shall be sized by the Continuing Authority.

b. Curb Boxes shall be Mueller H-15209 with compression connections on both ends. Curb boxes shall be extended to grade and clearly marked. Curb boxes shall be sized by the Continuing Authority.

4. Service Piping
   a. Type K copper tubing sized by the Continuing authority shall be buried with a minimum of 42-inches of cover. Service lines must be inspected by the Continuing Authority prior to backfilling.
   b. PVC service lines are permitted **only on approval** of the Continuing Authority.
5. Water Meters
   a. Water meters shall be sized by the Continuing Authority. All meters must be preceded immediately by a ball valve. Meters shall be equipped with an approved dual check valve. Meters are to be installed according to the manufactures recommendations.
   b. Outdoor installation of water meters shall be inspected by the Continuing Authority prior to use. Contact the Continuing Authority of approved materials for outdoor installation.

PART 3 - EXECUTION

3.1 EXCAVATION CLASSIFICATIONS

A. Class A Excavation
   1. Class A excavation shall consist of all other materials not mentioned in Class B excavation. The decision of the Continuing Authority shall be final on the determination of the proper classification.

B. Class B Excavation
   1. Any material which cannot be excavated by any other process other than drilling and blasting or drilling and wedging shall be determined to be Class B excavation. Class B excavation shall be defined as solid rock. All Class B excavation shall be stripped clear to allow for measurement prior to payment.

   2. Explosives shall only be used when permitted by the Continuing Authority. Only an insured State licensed blaster shall be permitted to perform the work. The blaster shall use all OSHA Safety Guidelines when working. Any and all damages incurred as a result of the blasting shall be the responsibility of the contractor and the blaster.

   3. Measurement of the Class B excavated material shall be determined as in-place cubic yardage. Pay limits are established as the required trench width as defined below. Any over-excavation required to install the water line will be at the contractor's expense.

3.2 TRENCH LOCATION

A. Horizontal & Vertical Separation with Sewers
   1. Horizontal Separation: Water mains shall maintain a minimum of 10 feet horizontal separation form sanitary sewer lines, storm sewer lines, and/or manholes. The horizontal separation shall be measured from the nearest edge of the water main to the closet edge of the sewer main.

2. Vertical Separation: Water mains shall maintain a minimum of 18-inches cover over the sewer main. The separation distance shall be measured from the bottom of the water main to the top of the sewer main.
3. Unusual Conditions: When minimum separations distances cannot be met and the water or sewer line cannot be relocated, minimum separation distances may be reduced by the following methods
   a. Approval of the Continuing Authority must be obtained.
   b. The water main shall be laid with a full-length cast iron pipe. The pipe shall be located such that the pipe joints will be located as far as possible for the crossing. (ie. center of pipe at center or crossing) concrete encasement shall be placed 10-feet from the crossing point in both directions. The sewer line and the water line must be encased. Contact the Division of Health for alternate methods.

B. Location in Easements
1. The water line shall be constructed in the plated easements as shown on the drawing. The contractor is responsible for any and all work performed outside of the established easements. The contractor is responsible for any and all damages incurred due to work outside the easements.

3.3 EXCAVATION OF TRENCHES

C. Trenches
1. Trench Depth
   a. Trenches shall have a minimum of 42" of cover over the top of the water line. Holes for the pipe bells shall be excavated to allow full and continuous support along the length of the pipe. The bottom of the trench shall be free of rocks, roots, or any other material that may damage the pipe. When trench bottom is unsuitable for laying the pipe directly on the bottom of the trench, 6-inchs of 1-inch minus material shall be used for bedding.
2. Trench Width & Pay Line
   a. No excavation shall be wider than one and four tenths (1.4) times the pipe diameter in inches plus 12-inches (W=1.4(D")+12). Two feet shall be the minimum trench width. Pay limits will be established using the following equation. Contractor is responsible for all excavation beyond the pay limits.
3. Trench Excavation
   a. The Contractor shall control the grading to prevent surface ground water from running into the excavated areas. Any water or other liquid wastes, which accumulated in the excavations, shall be removed promptly.

   b. The Contractor shall perform all excavation work necessary for and incidental to the proper construction of the water lines as shown on the approved plans or directed by the Continuing Authority. Excavation shall include the removal of trees, shrubs, and undesirable material. Excavation shall be done along the lines indicated on the approved plans and shall be continuous and straight. During excavation, material suitable for backfilling shall be stockpiled in an orderly manner a sufficient distance from the banks of the trenches to avoid overloading. All excavated material not suitable for backfill shall be removed by the Contractor and disposed of in a manner approved by the owner. The Contractor shall provide all barricades, lights, temporary crossings, warning signs, etc. that may be necessary to properly protect the public and the work from injury or damage.

3.4 PIPE LAYING

D. Installation
   1. Laying Pipe
      a. Laying of the pipe shall be commenced immediately after the excavation is started. The Contractor shall keep laying pipe closely behind the trenching operation. The Continuing Authority may stop the trenching when, in its opinion, the trench is opened too far in advance of the pipe laying operation. The Contractor shall lay the pipe in accordance with the manufacturer's instructions and recommendations, and in a manner that will not damage the pipe.
      b. When construction ends, the end of the pipe shall be securely plugged to prevent the entrance of debris or other contaminants from entering the pipe.
      c. In the event that the trench becomes inundated with water. The contractor shall excavate a pit adjacent to the main trench line and install a trash pump or similar device capable of removing the accumulated water from the trench. All water within the trench shall be removed from the trench prior to resuming construction of the water line.
   2. Thrust Blocking
      a. Lines shall be thrust blocked at bends, tees, and hydrants to prevent movement of lines under pressure. The concrete blocking shall be placed between solid ground and the fitting to be anchored in such a manner that the pipe and fitting joints will be accessible for repairs. Thrust blocks shall be constructed in accordance with the table shown on the detail drawing.
      b. Restraining Glands shall be used on all mechanical joint connections. Mega Lug manufactured by EBBA Iron or approved substitute shall be used.
      c. Duc Lugs or Tie Rods shall be used. Contractor shall consult manufactures specifications for size and quantity of rods required for the rated pressure.
   3. Damaged pipe will not be allowed. All damaged pipe shall be replaced at the contractor's expense, and under no circumstances shall damaged pipe be installed.

3.5 TRENCH BACKFILL

E. Backfill
   1. Backfill
      a. When the pipe is laid, the Contractor shall backfill under and around the pipe until the pipe is covered with sufficient material to hold the pipe in position when firmly tamped. The remainder of the trench shall then be carefully backfilled simultaneously on both sides of the pipe. Broken concrete or pavement, blasted rock and large boulders shall not be used as backfill materials. Any trenches improperly backfilled, or where settlement occurs shall be repaired as directed by the Continuing Authority. The ground shall be graded to a reasonable uniformity and the required amount of mounding over the trenches left in a uniform and neat condition. Before final acceptance is made, the Contractor shall travel the line with the Continuing Authority to locate any places requiring repair. It is the intent of these Specifications to secure a condition where no further settlement of trenches will occur after backfilling is completed.
   2. Backfill Under Paved Areas
      a. In areas of existing or proposed pavement or rock surfaces, the entire backfill shall consist of well-graded one (1) inch minus crushed limestone. The backfill material shall be compacted by an acceptable method to insure that no settlement of the completed backfill will occur. All areas of existing pavement damaged during

construction shall be repaved to the specifications of the Appropriate Governing Authority. Edges of the existing pavement shall be neatly cut in a straight line, removing all damaged pavement, prior to repaving.

3. Backfill Settlement
   a. The Contractor shall be responsible for the satisfactory compaction of backfill material described. If any trenches or other excavation are found to have settled, they shall be immediately reworked by the Contractor and restored to the specified grades. In addition, the Contractor shall be responsible for all damage or damages which might result from settlement of backfill made by him of the fulfillment of his contract within and during the period of one (1) year from and after the date of final acceptance

3.6 WATER LINE TESTING

F. Hydrostatic Testing
   1. All newly laid lines shall be tested before being placed in service. Trenches may be backfilled as the pipe is laid; or where practicable, trenches or bell holes may be left open for visual inspection during tests. Prior to making tests, all air shall be expelled from the pipe. If hydrants or blow-offs are not available at high points of the lines, suitable taps shall be provided at such points
   2. A two-hour hydrostatic test conforming to AWWA C600 shall be made on the pipeline between valves or temporary plugs at a test pressure of at least fifty (50) percent in excess or normal operating pressure. Any open trench or bell holes may over dry joints and may be backfilled following this test. Where trenches have been backfilled prior to making the test, any leaks evident at the surface shall be remade and retested. All pipes, fittings, valves, hydrants, and other materials found defective under this test should be removed and replaced.
   3. After hydrostatic tests have been satisfactorily completed, a two (2) hour leakage test shall be made on the pipeline valves or temporary plugs at a constant test pressure of seventy-five (75) pounds per square inch. Leakage in the test system shall be measured through a meter or approved measuring device. The allowable leakage shall not be greater than seventy (70) gallons per 24-hour day per mile of pipe per inch nominal diameter of pipe. Should tests disclose leakage greater than the allowable amount, locate and repair defective joint(s) until the leakage is within the specified allowance.
   4. All water line testing shall be performed in the presence of a representative of the Continuing Authority.

WATER LINE DISINFECTION

G. Preparation
   1. The interior of all pipe, fittings, and other accessories shall be kept free as possible from dirt and foreign matter at all times. Every precaution shall be used to protect the pipe against the entrance of foreign material before the pipe is placed in the new line. At the close of the day's work or whenever the workmen are absent from the job, the end of the last laid section of pipe shall be plugged, capped or otherwise tightly closed to prevent the entry of foreign material of any nature. If the pipe laying crew cannot put the pipe into the trench and in place without getting earth into it, the Continuing Authority may require that before lowering the pipe into the trench, a heavy, tightly woven canvas bag of suitable size shall be placed over each end, and left there until the connection is to be made to the adjacent pipe.

2. At times when pipe laying is not in progress, the open ends of pipe shall be closed by a watertight plug. Joints of pipe in the trench shall be made before the work is stopped. The provision shall apply during the noon hour as well as overnight.

H. Flushing & Sterilizing

1. Sterilizing of the completed line shall be done in a manner approved and recommended by the Missouri Division of Health. Prior to chlorination, the main shall be flushed as thoroughly as possible with the water pressure and outlets available. Flushing shall be done after the pressure tests are made. It must be understood that such flushing removes only the lighter solids and cannot be relied upon to remove heavy material allowed to get into the main during laying, Unless extreme care and thorough inspection is practiced during the laying of water mains, small stones, pieces of concrete, particles of metal, or other foreign material may gain access to mains newly laid. If it is believed that such foreign material may be in the main, it shall be thoroughly flushed and valves carefully inspected after flushing to see that the entire valve operating mechanism is in good condition.
2. Subsequent to flushing, the following procedure shall be followed in disinfecting the water mains.

   a. Close off section of distribution system that is to be disinfected.
   b. Prepare one (1) percent chlorine solution as shown in the following table:

Product	Amount of Compound	Quantity of Water to Add to make 1% Solution
High Test Calcium Hypo-Chlorite (65-70% Chlorine, HTH Parachloron, etc.)	1 lb.	7.5 gal.
Chlorinated Lime (32-35% Chlorine)	2 lbs.	7.5 gal.
Liquid Laundry Bleach (Purex or Chlorox)	1 gal.	4.25 gal.

   c. The amount of chlorine required per one hundred (100) feet length of various pipe sizes is as shown in the following table:

Pipe Size (in)	Pipe Size (gal)	Volumeof 100 ft. Length 100% Chlorine (lb.)	Amount Required to Give 25 ppm Chlorine 1% Chlorine/Water (gal.)
2	16.4	0.0034	1/24
4	65.3	0.0135	1/6
6	146.5	0.0305	3/8
8	261.0	0.054	2/3
10	408.0	0.085	1
12	588.7	0.123	1 ½

d. Introduce the chlorine solution with a positive displacement type pump at the same point where the water will be introduced into the section to be disinfected.

e. Fill the pipe slowly and be sure not to trap any air in the pipe. Close the section off that is to be disinfected when the pipe is full and under slight pressure. The solution should be allowed to remain in the pipe for twenty-four (24) hours.

NOTE: The detention time may be cut to three (3) hours, provided a one-hundred (100) ppm chlorine solution is used in place of the 25 ppm chlorine solution.

f. All valves or other appurtenances in the line being disinfected should be operated while the system is being filled with the chlorine solution.

3. Following sterilizing, all treated water shall be thoroughly flushed from the newly laid pipeline at its extremities until the replacement water throughout its length shall, upon test, be proved comparable to the quality of water approved by the Public Health Authority having jurisdiction. The Contractor or his Representative shall arrange for any bacteriological testing of water samples that may be required. This quality of water delivered by the new main should continue for a period of at least two (2) full days, as demonstrated by laboratory examination of samples taken from a tap located and installed in such a way as to prevent outside contamination. Samples should never be taken from an unsterilized hose or from a hydrant, because such samples seldom meet current bacteriological standards.

4. Should the initial treatment fail to result in the condition specified in the preceding paragraph, the sterilization procedure shall be repeated until such results are obtained.

3.7 FINISH GRADING

I. Finish Grading

1. During the progress of the work, the Contractor shall remove and properly dispose of all debris and waste material. Upon completion and acceptance of the work, remove from the property of the Owner all equipment and facilities and unused materials provided by the contractor in connection with the work and leave the grounds in a clean and orderly condition. Any and all areas that are disturbed as a result of construction shall be restored to an "as good or better" condition as existed prior to being disturbed.

3.8 SAFTEY

J. The contractor shall follow all current OSHA guidelines at all times during construction.

END OF SECTION 2511

SECTION 02525 - WATER SUPPLY WELLS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Submersible-type pumps for water supply wells.
   2. Associated specialties.

B. See Division 2 Section "Water Distribution" for water-service, fire-service-main, and combined water-service and fire-service-main piping.

1.2 PERFORMANCE REQUIREMENTS

A. Minimum Tested Water Supply Well Performance Capacity: 87 gpm. Final capacity will be determined by the required pump test.

B. Well driller must be certified by The State of Missouri to drill this type of well.

C. The well driller is required to contact Missouri Department of Natural Resources, State Geologist prior to drilling the well. The driller shall perform the required samples as described by state requirements. These samples will determine the final properties of the well.

1.3 UNIT PRICES

A. Unit-Price Amounts: As stipulated in the Form of Agreement.

B. Measurement and Payment Procedures:
   1. Measurement of the well shall be made from the existing ground surface to the bottom of the well. Measurement of the well casing shall be measured from the top of the casing to the bottom of the casing. Measurement of the surface casing shall be measured from the top of the casing to the bottom of the casing.
   2. Unit Prices as determined by the agreement shall be used for final payment based on final measurements.

C. Measurement Units for Water Supply Wells, Casings, and Grout: Per linear foot of well depth.

1.4 SUBMITTALS

A. Product Data: Submit certified performance curves and rated capacities of selected well pumps and furnished specialties for each type and size of well pump indicated.

B. Shop Drawings: Show layout and connections for well pumps.

   1. Wiring Diagrams: Power, signal, and control wiring.

C. Field quality-control reports.

D. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. AWWA Compliance: Comply with AWWA A100 for water supply wells.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2.2 WELL CASINGS

A. Surface Casing
1. Well Casing shall be sized in according to MO~DNR 10 CSR 23-3 Steel Casing Table and shall be sized as shown on the drawings.

B. Well Casing
1. Well Casing shall be sized in according to MO~DNR 10 CSR 23-3 Steel Casing Table and shall be sized as shown on the drawings.

C. Discharge Piping
1. Steel Pipe shall meet AWWA C200, single ply, steel pipe with threaded ends and threaded couplings for threaded joints
2. Two inline check valves shall be installed in the discharge piping. The first inline check valve shall be placed approximately 25-feet above the well pump. The second valve shall be placed approximately 175-feet above the pump. Inline check valves shall be Flowmatic or Technocheck sized for the discharge column as shown on the drawings.

D. Well Sanitary Seals: Casing cap, with holes for piping and cables, that fits into the casing and is removable, waterproof, and vermin proof.

2.3 WATER WELL SCREENS

A. Screen Material: Fabricated of ASTM A 666, Type 304 stainless-steel tube; with slotted or perforated surface and designed for well-screen applications.

1. Screen Couplings: Butt-type, stainless-steel, coupling rings.
2. Screen Fittings: Screen, with necessary fittings, closes bottom and makes tight seal between top of screen and well casing.
3. Maximum Entering Velocity: 0.1 fps.

2.4 SUBMERSIBLE-TYPE WELL PUMPS

A. Manufacturers:
1. Grundfos.
2. Berkeley/Sta-Rite
3. Pentair Pump Group; F. E. Myers
4. Submaster Pumps.

B. Description: Submersible-type, vertical-turbine well pump complying with HI 2.1-2.5 or AWWA E101, with the following features:

1. Impeller Material: Stainless steel.
2. Motor: Capable of continuous operation under water, with protected submersible power cable.
3. Column Pipe: ASTM A 53, Schedule 40, galvanized steel pipe with threaded ends and cast-iron or steel threaded couplings.

PART 3 - EXECUTION

3.1 PREPARATION

A. Pilot-Hole Data: Pilot hole is not required but is recommended. Boring samples from the pilot hole shall be taken in accordance with Mo~DNR guidelines and they shall be submitted to the State Geologist for review. The State Geologist will use these samples to determine the final casing depth and total depth of the well. A copy of this report shall be furnished to Owner.

3.2 INSTALLATION

A. Construct well using air driven rotary or rotary percussion method.

B. Enlarge pilot hole and install permanent casing, screen, and grout. Install first section of casing with hardened steel driving shoe of an OD slightly larger than casing couplings if threaded couplings are used.

C. Set casing and liners round, plumb, and true to line.

D. Join casing pipe as follows:

1. Ream ends of pipe and remove burrs.
2. Remove scale, slag, dirt, and debris from inside and outside casing before installation.
3. Cut bevel in ends of casing pipe and make threaded joints.
4. Clean and make either full circumferential welds or threaded coupling joints.

E. Provide permanent casing with temporary well cap. Install with top of casing 12 inches above finished well house floor.

F. Develop wells to maximum yield per foot of drawdown.

1. Extract maximum practical quantity of sand, drill fluid, and other fine materials from water-bearing formation.
2. Avoid settlement and disturbance of strata above water-bearing formation.
3. Do not disturb sealing around well casings.
4. Continue developing wells until water contains no more than 2 ppm of sand by weight when pumped at maximum testing rate.

G. Install submersible-type well pumps according to HI 2.1-2.5 and provide access for periodic maintenance.

1. Before lowering permanent pump into well, lower a dummy pump that is slightly longer and wider than permanent pump to determine that permanent pump can be installed. Correct alignment problems.
2. Before lowering permanent pump into well, start pump to verify correct motor rotation.
3. Securely tighten discharge piping joints.
4. Connect motor to submersible pump and locate as determined by Mo~DNR near well bottom.

    a. Connect power cable while connection points are dry and undamaged.
    b. Do not damage power cable during installation; use cable clamps that do not have sharp edges.
    c. Install water-sealed surface plate that will support pump and piping.

H. See Division 2 Section "Utility Materials" for basic piping joint construction.

3.3 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

1. Connect piping between well pump and water piping.
2. Connect building water distribution to well pipe inside well house.

B. Electrical wiring, connections, and pump controllers are specified.

C. Ground equipment according to NEC Electrical Codes.

3.4 WELL ABANDONMENT

A. Follow well-abandonment procedures of Missouri Department of Natural Resources. Restore ground surface to finished grade.

3.5 FIELD QUALITY CONTROL

A. Plumbness and Alignment Testing: Comply with AWWA A100, Section 8.

B. Water Samples, Records, and Reports: Take samples of substrata formation at Mo~DNR pre determined intervals and at changes in formation throughout entire depth of each water supply well. Carefully preserve samples on-site in glass jars properly labeled for identification.

1. Furnish samples of water-bearing formation to testing laboratory and well-screen manufacturer for mechanical sieve analysis.
2. Prepare reports on static level of ground water, level of water for various pumping rates, and depth to water-bearing strata.

C. Performance Testing: Conduct final pumping tests after wells have been constructed, cleaned, and tested for plumbness and alignment.

1. Provide discharge piping to conduct water to locations where disposal will not create a nuisance or endanger adjacent property. Comply with requirements of Mo~DNR.
2. Measure elevation to water level in wells.
3. Perform two bailer or air-ejection tests to determine expected yield. Test at depths with sufficient quantity of water to satisfy desired yields.
4. Test Pump: Variable capacity test pump with capacity equal to maximum expected yields at pressure equal to drawdown in wells, plus losses in pump columns and discharge pipes.
5. Start and adjust test pumps and equipment to required pumping rates.
6. Record readings of water levels in wells and pumping rates at Mo~DNR or AWWA required rates.
7. Record maximum yields when drawdown.
8. Operate pumping units continuously as required after maximum drawdown is reached.
9. Record returning water levels in wells and plot curves of well recovery rates.
10. Remove sand, stones, and other foreign materials that may become deposited in wells after completing final tests.

D. Water Analysis Testing: Make bacteriological, physical, and chemical analyses of water from each finished well and report the results. Make analyses according to requirements of authorities having jurisdiction.

E. Start well pump and adjust controls and pressure setting. Replace damaged and malfunctioning controls and equipment.

3.6 CLEANING

A. Disinfect water supply wells according to AWWA A100 and AWWA C654 before testing well pumps.

B. Follow water supply well disinfection procedures required by Mo~DNR.

3.7 PROTECTION

A. Water Quality Protection: Prevent well contamination, including undesirable physical and chemical characteristics.

B. Ensure that mud pit will not leak or overflow into streams or wetlands. When well is accepted, remove mud and solids in mud pit from Project site and restore site to finished grade.

C. Provide casings, seals, sterilizing agents, and other materials to eliminate contamination; shut off contaminated water.

D. Exercise care to prevent breakdown or collapse of strata overlaying that from which water is to be drawn.

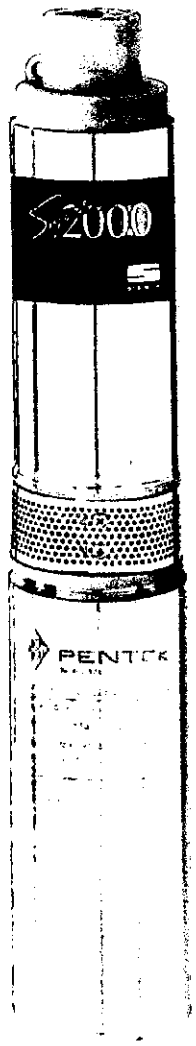
E. Protect water supply wells to prevent tampering and introducing foreign matter. Retain temporary well cap until installation is complete.

END OF SECTION 02525

STA-RITE

well

4" submersible pumps – 10, 15, 20, 30, and 50 gpm



POWERED BY PENTEK Pentair Water

Precision-engineered, high-quality, rugged Signature 2000® Stainless Steel Series Pumps deliver efficient, dependable performance even in rough, aggressive water. Heads to 1,950 feet and capacities to 65 GPM. Built to deliver long-term, trouble-free service. Floating impeller design resists sand and reduces sand locking. These pumps feature the patented SignaSeal™ staging system.

APPLICATIONS

- **Water systems...** for residential, industrial, commercial, multiple housing and farm use.

SPECIFICATIONS

Shell – Stainless steel
Diameter – 3-7/8"
Discharge – Stainless steel
Discharge Bearing – Nylatron®
Intermediate Bearing – (On larger units) Polycarbonate, nitrile rubber and stainless steel
Impellers – Acetal
Diffusers – Polycarbonate
Suction Caps – Polycarbonate with stainless steel insert
Thrust Pads – Proprietary spec.
Shaft and Coupling – Stainless steel
Intake – Stainless steel
Intake Screen – Polypropylene
Cable Guard – Stainless steel
Check Valve – Acetal†
Agency Listings – CSA

Signature 2000®

STAINLESS STEEL

FEATURES

Patented Staging System – Our proven SignaSeal™ staging system incorporates a harder-than-sand ceramic wear surface that when incorporated with our floating impeller design, greatly reduces problems with abrasives, sand lock-up and running dry.
Discharge – Corrosion-resistant 300 grade stainless steel for durability in aggressive water. Large octagon wrench area for ease of installation.
Discharge Bearing – Exclusive self-lubricating Nylatron® bearing resists wear from sand.
Intake – Corrosion-resistant 300 grade stainless steel for durability in aggressive water.
Shaft – Positive drive from 7/16" hexagonal heavy-duty 300 grade stainless steel.
Coupling – Stainless steel press fit to pump shaft. Couples to all standard NEMA motors.
Shell – Highest grade, heavy-walled corrosion-resistant stainless steel. Threaded for easy servicing.
Hardware – All screws, washers and nuts are corrosion-resistant 300 grade stainless steel.
Check Valve† – Durable internal spring-loaded check valve.
Cable Guard – Corrosion-resistant stainless steel guard protects motor leads. Tapered ends prevent pump from catching on well.
Intake Screen – Corrosion-proof.
PENTEK® XE Motor – 2 and 3 wire NEMA standard all stainless construction water-filled motors.

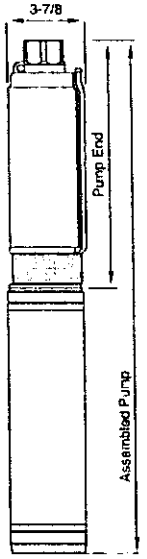
†Except where noted.

STA-RITE

well

4" submersible pumps – 10, 15, 20, 30, and 50 gpm

OUTLINE DIMENSIONS – 10, 15, 20, AND 30 GPM

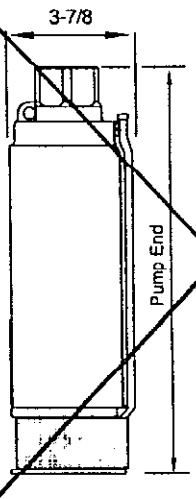


Discharge	
10 GPM	1-1/4" NPT
15 GPM	1-1/4" NPT
20 GPM	1-1/4" NPT
30 GPM	2" NPT

For lengths, refer to Ordering Information tables.

Dimensions (in inches) are for estimating purposes only.

OUTLINE DIMENSIONS – 50 GPM

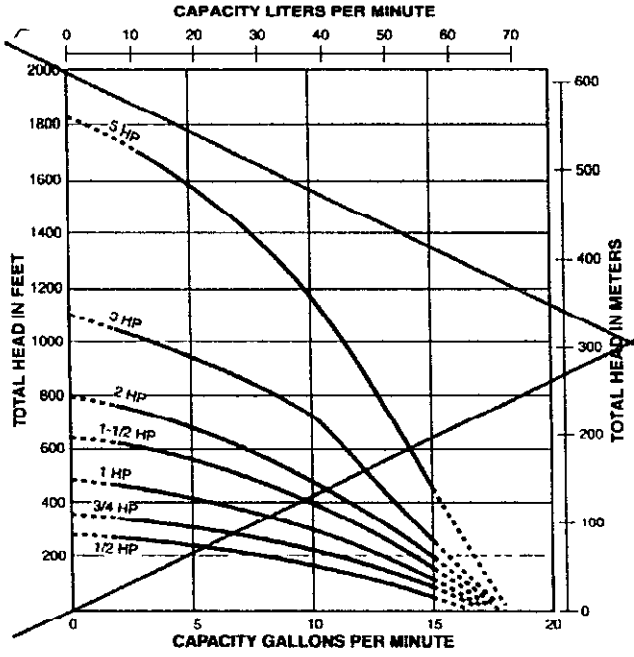


Discharge	
50 GPM	2" NPT

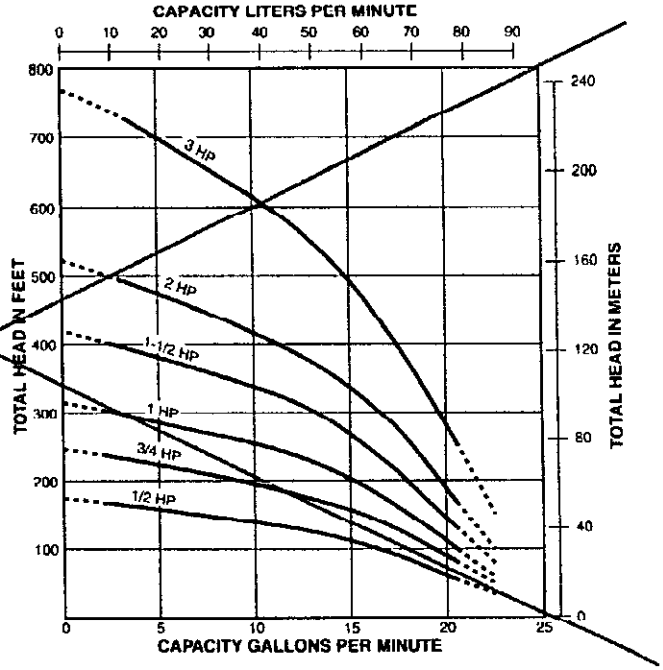
Pump diameter is 3-7/8". For lengths, refer to Ordering Information tables.

Dimensions (in inches) are for estimating purposes only.

PUMP PERFORMANCE – 10 GPM



PUMP PERFORMANCE – 15 GPM



Tested and rated in accordance with Water Systems Council standards.

NOTE: Pumps installed with a PRO-Source™ tank require a 100 PSI relief valve. Pumps installed with a conventional tank require a 75 PSI relief valve. Relief valve must be capable of relieving entire flow of pump at relief pressure.

STA-RITE

Well

4" submersible pumps – 10, 15, 20, 30, and 50 gpm

30 Gallons per Minute — PUMP PERFORMANCE *(Capacity in Gallons Per Minute)*

HP	PSI	Pumping Depth in Feet																			Shut-Off Head	
		20	40	60	80	100	125	150	175	200	250	300	350	400	450	500	550	600	650	700	Feet	PSI
1	0	44.0	42.5	40.9	39.1	36.8	32.5	26.0	8.0												175	76
	20	40.4	38.8	36.0	32.4	27.7	13.5															
	30	38.0	35.3	31.7	26.3	14.3																
	40	35.0	31.4	25.9	17.1																	
	50	30.2	24.0	3.0																		
	60	21.9																				
1-1/2	0	44.2	43.1	41.9	39.9	37.5	34.1	30.9	26.9	17.0											210	91
	20	41.2	39.1	36.5	34.0	31.5	27.8	21.5														
	30	38.9	36.1	33.8	31.0	27.9	21.8															
	40	36.0	33.5	30.8	27.7	20.2																
	50	32.9	30.1	26.8	21.5																	
	60	29.5	25.9	18.1																		
2	0	44.9	43.9	43.0	41.8	40.5	38.8	36.8	34.7	31.6	23.7										280	121
	20	42.7	41.3	40.1	38.7	37.1	34.9	32.1	29.0	24.8												
	30	41.2	40.0	38.5	37.0	35.0	32.2	29.1	24.9	15.2												
	40	39.9	38.3	36.6	34.8	32.7	29.8	25.1	16.1													
	50	38.0	36.3	34.5	32.1	30.0	25.3	7.5														
	60	36.0	34.0	31.9	29.1	26.0	18.0															
3	0	45.0	44.5	44.0	43.2	42.2	41.0	40.1	39.0	38.2	35.5	32.0	27.3								420	182
	20	43.8	43.0	42.4	41.5	41.0	39.8	38.5	37.1	35.7	32.1	28.0	18.5									
	30	42.9	42.2	41.3	40.6	39.9	38.7	37.2	35.8	34.2	30.3	24.9	6.0									
	40	42.1	41.2	40.4	39.7	38.8	37.3	35.9	34.5	32.6	28.3	19.9										
	50	41.1	40.3	39.5	38.5	37.4	36.0	34.6	32.7	31.0	25.2	9.5										
	60	40.2	39.3	38.3	37.2	36.1	34.7	32.8	31.0	28.5	20.5											
5	0	—	—	—	44.3	44.0	43.5	43.0	42.6	42.0	40.7	39.2	38.0	36.0	34.2	31.9	29.2	26.0	20.0		705	305
	20	—	44.1	44.0	43.4	43.1	42.7	42.0	41.3	40.8	39.3	38.2	36.2	34.4	32.4	30.0	26.1	21.5				
	30	44.1	43.9	43.4	43.0	42.8	42.1	41.4	40.8	40.1	38.7	37.0	35.1	33.1	31.1	26.0	24.1	16.0				
	40	43.8	43.4	43.0	42.7	42.1	41.5	40.9	40.2	39.3	37.9	36.1	34.3	32.0	29.4	26.2	20.4					
	50	43.3	43.0	42.6	42.0	41.5	41.2	40.2	39.5	38.8	37.1	35.4	33.2	31.2	28.8	24.5	16.0					
	60	42.9	42.5	42.0	41.4	41.1	40.3	39.8	38.9	38.1	36.2	34.2	32.1	30.0	26.7	22.0						

HP	PSI	Pumping Depth in Feet													Shut-Off Head	
		200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	Feet	PSI
7-1/2	0	—	43.2	40.4	37.6	34.8	32.0	28.1	20.0						425	422
	20	44.6	42.0	39.3	36.5	33.8	30.5	25.5	13.8							
	30	44.2	41.5	38.6	35.8	33.1	29.8	23.3	6.5							
	40	43.6	40.7	38.1	35.6	32.6	29.3	21.7								
	50	42.7	40.1	37.3	34.6	31.7	27.4	19.3								
	60	42.0	39.4	36.5	33.7	30.7	25.1	13.9								
10	0	—	44.7	43.1	41.3	39.5	37.3	35.1	33.1	30.4	27.1	22.5	11.9		1345	582
	20		44.2	42.3	40.5	38.6	36.4	34.5	31.8	29.2	25.3	18.7				
	30	—	43.7	42.0	40.	43.0	35.7	33.7	31.3	28.4	24.2	16.3				
	40	44.9	43.3	41.6	39.7	37.7	35.5	33.5	30.9	27.7	23.4	14.4				
	50	44.6	42.7	41.0	39.1	37.1	34.9	32.8	30.2	26.7	21.7	7.7				
	60	44.3	42.3	40.5	38.7	36.5	34.5	32.1	29.5	25.7	20.1	5.0				

CAUTION: DO NOT use pump at flow rates indicated by the symbol . To do so can cause premature failure of unit. Pump warranty void when failure occurs under these conditions. Tested and rated in accordance with Water Systems Council Standards.

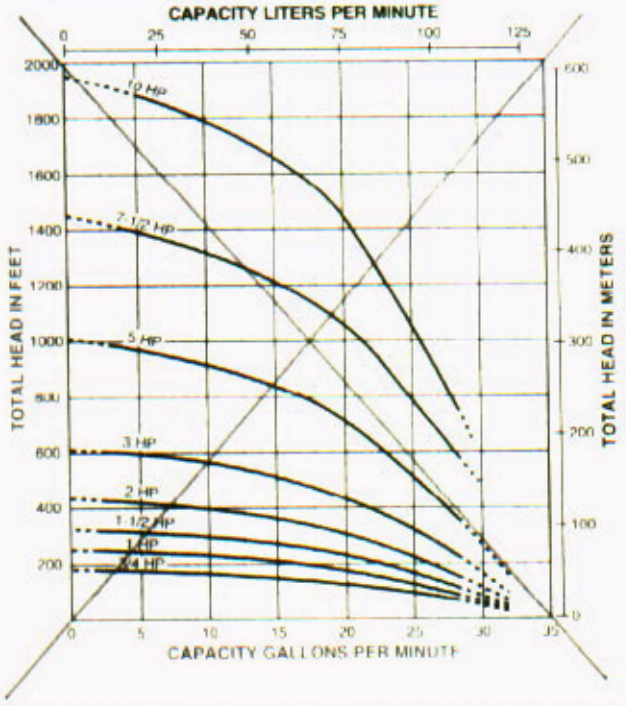
NOTE. Pumps installed with a PSB (pressure sensing) tank require a 150 PSI relief valve. Pumps installed with a conventional tank require a 75 PSI relief valve. Relief valve must be capable of relieving entire flow of pump at relief pressure.

STA-RITE

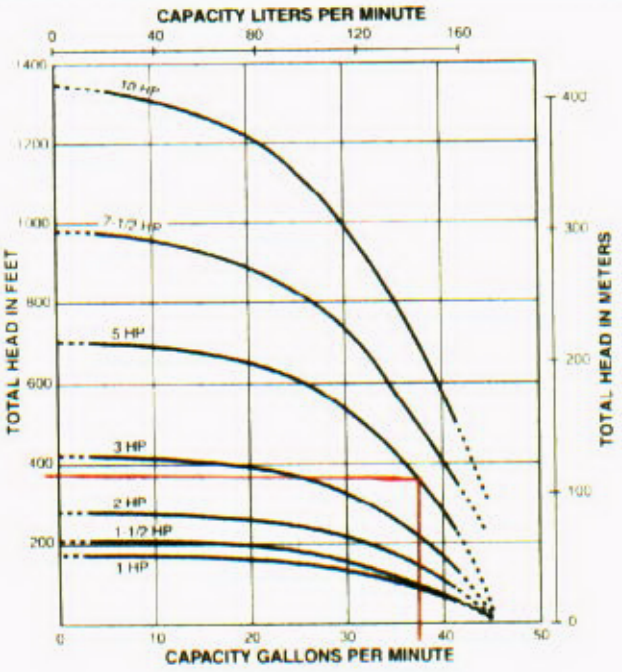
well

4" submersible pumps – 10, 15, 20, 30, and 50 gpm

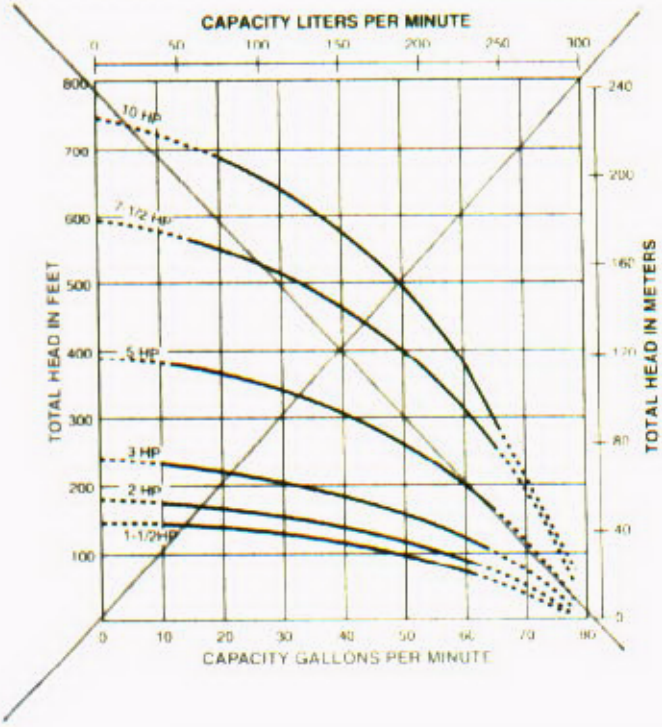
PUMP PERFORMANCE – 20 GPM



PUMP PERFORMANCE – 30 GPM



PUMP PERFORMANCE – 50 GPM



Total Head = 300' + 30 psi

= 368.2'

SECTION 2526 — WELL GROUTING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the allowable methods for grouting the well casing.

1.2 QUALITY ASSURANCE

A. Installer Qualifications: it is the responsibility of the well installation contractor to ensure that the annular space is sealed and that the casing does not leak. This obligation and responsibility ends three years after the date of certification unless it can be shown that the well seal has been damaged by other persons.

B. Grouting of the well shall be in compliance with 10-CSR-23-3 (3) grouting.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All materials used to grout well casing shall be in accordance with MO~DNR Guidelines:
   1. Cement
   2. Bentonite slurry

2.2 MIXES

A. Mixes shall be in accordance with MO~DNR Guidelines. It shall be the responsibility of the contractor to verify the allowable mixture type and quantity. The contractor shall confirm mixture with MO~DNR prior to installing the grout.

PART 3 - EXECUTION

3.1 GROUTING METHODS

1. The contractor shall contact MO~DNR to confirm the appropriate method of placing the grout around the well.
2. One of the following methods shall be used.
   a. Tremie method
   b. Pressure grouting through tremie method

c. Pressure grouting through the casing method
d. Positive displacement method

3.2 INSTALLATION

A. Tremie Method
1. The grout is placed in the annular space by gravity through a tremie or grout pipe suspended in the annular space. The tremie pipe is placed into the annulus and extends to within five feet from the bottom of the interval to be grouted. The grout is added into the tremie pipe, which should remain submerged in the grouting material during the entire time the grout is being placed. The tremie pipe is gradually withdrawn as the grouting material is placed or may be removed after the annular space is full and before the grout sets.

B. Pressure Grouting Through Tremie Method
1. For this method the same procedure is followed as described in the tremie method, except the grout is pumped into the tremie pipe instead of placed by gravity flow.

C. Pressure Grouting Through the Casing Method.
1. A grout pump is attached to the top of the casing and grout is pumped through the casing and allowed to fill the annular space from the bottom. Pumping continues until grout reaches the surface of the annular space. The grout shall be allowed to set for 72 hours before drilling continues.

D. Positive Displacement Method
1. Casing is set into the borehole to a point about five feet above the casing point. Grout is poured into the well casing followed by a drillable plug. This is designed to push all grout to the bottom of the well. If there is water in the borehole and bentonite or cement slurry is used it must be emplaced by means of a tremie to the bottom of the borehole. A plug is pushed to the bottom of the casing forcing the grout down the inside of the casing and up the annular space. The casing is then set into the bottom of the drill hole.

END OF SECTION

SECTION 5509 - GROUND WATER STORAGE TANK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the requirements for construction of the ground water storage tank:

1.3 DEFINITIONS

A. Missouri Department of Natural Resources ; Mo~DNR

B. American Water Works Association; AWWA

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide a ground water storage tank capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Wind Loads: Determine loads based on the following minimum design wind pressures:

a. Uniform pressure of 20 lb/sq. ft., acting inward or outward.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Data: For the following:

1. Ground Water Storage Tank

C. Product Data: Include rated capacities; shipping, weight.

D. Shop Drawings: Show fabrication and installation details for ground water storage tank.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Contractor shall be responsible for delivery, storage and handling.

1.7 WARRANTY

A. Special Warranty: manufacturer in which manufacturer agrees to repair or replace components of Ground Water Storage Tank that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures.
b. Faulty operation of piping or venting equipment.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

B. Warranty Period: 1 year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GROUND WATER STORAGE TANK

A. Tank Requirements
1. 12-foot inner diameter
2. 15-feet tall
3. Roof shall have a minimum of 3-inches of rise
4. Tank shall be constructed in accordance with AWWA D100

2.2 MATERIALS, GENERAL

A. Ground Storage Tank
1. The Ground Water Storage Tank shall be constructed from carbon steel.
2. The tank shall be continuously welded at all joints.
3. Tank shall be constructed in accordance with AWWA D100

B. Over Flow Pipe
1. A 4-inch over flow pipe shall be attached to the tank at the elevation shown on the drawings.
2. The overflow pipe shall be securely attached to the side of the tank and terminate 2-feet from the bottom of the tank.
3. A screened stainless steel #24 mesh shall be attached to the end of the over flow pipe
4. A 4-inch flap valve shall be attached to the end of the overflow pipe.

C. Inlet Pipe
1. 2-inch NPT fitting shall be extended through the tank for piping connection.
2. A 2-inch elbow shall be used to extend an inner 2-inch pipe 8-feet above the bottom of the tank. The inner 2-inch pipe shall be supported at 4-foot intervals and be securely fastened to the side of the tank.

D. Outlet Pipe
1. 3-inch NPT fitting shall be extended through the tank for piping connection.

2. A 3-inch elbow shall be used to extend the inner 3-inch discharge pipe 1-foot above the finish floor of the tank. The 3-inch pipe shall be securely fastened to the side of the tank.

E. Exterior Ladder
1. A ladder with side rails shall be mounted to the exterior of the tank. The ladder shall be extended to the top man access as shown on the plans.
2. The exterior ladder shall terminate 8-feet above the bottom of the tank.

F. Interior Ladder
1. A ladder with side rails shall be mounted to the interior of the tank..
2. The interior ladder shall terminate 1-foot above the bottom of the tank.

G. Roof Man Access
1. Roof access shall have a minimum inner opening of 24-inches.
2. Access shall be hinged and provide a water tight seal.
3. Access shall be located as shown on the plans.

H. Lower Man Access
1. Access shall be located as shown on the drawing.
2. Access shall provide a water tight seal.
3. Access shall be a minimum of 24-inches inside diameter.

I. Vent
1. A 4-inch pipe connected to a tee shall be provided as a vent. Both ends of the vent shall be screened with # 24 stainless steel mesh.
2. Alternate Mushroom Vent
   a. A mushroom vent shall be provided and located near the center of the roof.
   b. The vent shall provide a minimum of 100 square inches of open area and shall be screened with # 24 stainless steel mesh.

J. Drain Plug
1. A 4-inch NPT drain plug shall be provided as shown on the plans. The plug shall be included with the tank.

K. Probe Connection
1. A 2-inch NPT fitting shall be attached at the center of the tank to provide a connection for the well pump control probes.

L. Lift Rings
1. Lift Rings securely fastened to the tank shall be provided.
2. Lift Rings shall be suitable to load, unload, and erect the tank at the job site.

PART 3 - EXECUTION

3.1 Welding

A. Ground Water Storage Tank
1. Tank shall be welded in accordance with AWWA requirements.
2. Only AWWA certified welders will be allowed to weld on the tank

3. Manufacture shall test the tank for leaks prior to shipping the tank.

3.2 Assembly

A. The tank shall be completely assembled at the shop and shipped to the job site.

B. Exterior components that can be attached to pre welded brackets may be made removable for shipping purposes.

3.3 Offloading and Erection

A. The contractor shall supply equipment capable of lifting the tank for the purpose of off loading and placing the tank on the foundation.

3.4 Painting

A. Interior of the tank shall be painted by the manufacture to meet AWWA D100 and NSF standard 61 requirement.

B. Exterior
1. Tank shall be primed by the manufacture with Oxide Primer to prevent rusting.
2. Contractor shall paint the Exterior of the tank after erection with a Tenemic Brand paint owner select color.

3.5 STERILIZATION

A. The contractor shall sterilize the tank in accordance with AWWA C652 and the requirements of Mo~DNR.

B. Procedure
1. Tank shall be slowly filled to the overflow pipe.
2. Contractor shall introduce enough chlorine to create a concentration of 25 ppm.
3. After 24 hours the water shall be tested by a certified lab and shall have a concentration of 10ppm residual.
4. If test fails contractor shall repeat AWWA C652 until adequate results have been obtained.

3.6 Mo~DNR Notification

A. Prior to placing the tank into service the Mo~DNR shall be contacted for permission to distribute water.

END OF SECTION 5509

SECTION 5510 - HYDROPNEUMATIC STORAGE TANK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1.3 ASSEMBLY DESCRIPTION

A. Hydropneumatic Tank shall be constructed as drawn and tested prior to shipping to the site. The tank shall meet all required codes.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide Hydropneumatic Tank capable of withstanding the effects of gravity loads and meeting all requirements of the ASME Boiler Codes, AWWA D100 Standard for the following loads and stresses within limits and under conditions indicated:

1.5 SUBMITTALS

A. Shop Drawings: Show fabrication and installation details for the Hydropneumatic Tank.

1.6 DELIVERY, STORAGE, AND HANDLING

A. The hydropneumatic tank shall be delivered to the site. Upon delivery the contractor shall store the tank according to the manufactures guidelines and recommendations

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of Hydropneumatic Tank that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Structural failure under normal operating conditions.
    b. Any leaks due to poor workmanship.

B. Special Warranty: Contractor agrees to repair or replace components of Hydropneumatic Tank that fail within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failure due to improper storage.
b. Structural failure due to improper handling.

C. Warranty Period: 1 year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Quick Tanks Inc.

2. Continental Tanks

3. Hydropneumatic Tank:

B. The hydropneumatic tank shall meet the following requirements
1) ASME Boiler & Pressure Vessel Code
2) AWWA D100 Standard for Welded Steel Tanks.
3) ANSI/NSF Standard 61

2.2 Hydropneumatic Tank

A. Tank Dimensions and Required Pressure
1. Tank shall have a gross capacity of 1,078 gallons
2. Tank shall be approximately 4-foot diameter
3. Tank shall be approximately 12.5-feet in length.

B. Inlet and Outlet
1. Tank inlet shall be sized and located as shown on the drawing.
2. Tank outlet shall be sized and located as shown on the drawing.
3. 2- 2-inch threaded openings shall be installed on the top of the tank.
4. The tank shall be provided with a site glass as shown on the drawings.
5. 2, 1-inch threaded connections shall be mounted on the tank as shown on the drawings.

C. Man Access
1. An 18"x22" man entrance shall be provided. Entrance shall meet all codes.

D. Support Saddle
1. 12-inch wide metal saddles shall be provided on the tank as shown on the drawings.

2. Saddles shall provide a minimum of 24-inches of clearance below the bottom of the tank.

E. Coatings
1. Interior of the tank shall be coated according to ANSI/NSF Standard 61
2. Exterior of the tank shall be primed with an Oxide Primer to prevent rust.
3. Exterior of the tank shall be field coated by the contractor with Tenemic Brand Paint.

F. Tank shall be labeled with the following information:
1. Name of manufacturer
2. Maximum allowable pressure of the tank as determined by the ASME Boiler Code.

2.3 MATERIALS, GENERAL

A. Steel
1. All material shall meet the requirements of the ASME Boiler Codes. The Pressure Vessel shall be designed for 100 psi working pressure. The outer shell shall be sized using the ASME Boiler Codes to meet the required working pressure and the required factor of safety as defined by the ASME Boiler Codes.

PART 3 - EXECUTION

3.1 Assembly

A. Hydropneumatic tank shall be sand blasted to a white metal finish in the areas of the weld. The tank shall be completely assembled prior to testing.

3.2 Testing

A. Testing of the tank shall comply with the requirements of the ASME Boiler Codes. The tank shall be tested for any and all leaks.

3.3 Coating

A. Factor Coating
1. The interior of the tank shall be coated according to ANSI/NSF Standard 61
2. Exterior of the tank shall be primed with an Oxide Primer to prevent rust

B. Field Coating
1. Exterior of the tank shall be field coated by the contractor with Tenemic Brand Paint for metal exterior quality. Color shall be white.

3.4 Shipping & Handling

A. The tank shall be shipped to the site by the manufacturer.

B. The contactor shall be responsible for handling and storage of the tank upon arrival. The contractor is responsible for inspection of the tank for any damages during shipping.

3.5 Installation

A. Hydropneumatic tank shall be installed as shown on the drawings.

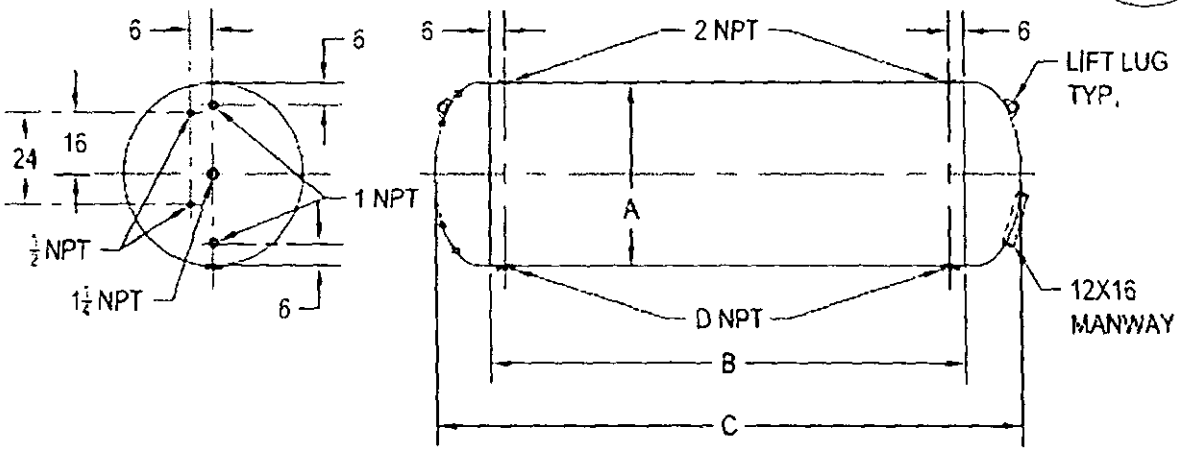
B. Contactor is responsible for all piping connections to the hydropneumatic tank.

END OF SECTION 5510

QUICK TANKS, Inc.

P.O.Box 338, Kendallville, IN 46755
800-348-2514 Fax 800-348-1514

ASME CODE QUICK HORIZONTAL (QHTC) TANKS
ANSI/NSF® STANDARD 61 LISTED LINING
100 PSIG WORKING PRESSURE



BELOW ARE DIMENSIONS FOR STANDARD TANK CAPACITIES.
OTHER CONFIGURATIONS ARE AVAILABLE UPON REQUEST.

CRADLE DIMENSIONS VARY WITH TANK DIAMETER.
NOTE: CRADLES ARE OPTIONAL AND *NOT* INCLUDED IN TANK PRICE.
LINING: ANSI/NSF STANDARD 61 ERTIFIED EPOXY
EXTERIOR: STANDARD EPOXY OR PRIMER.

MODEL NUMBER	GALLONS ACTUAL	- NOMINAL DIMENSIONS (INCHES) -				WEIGHT
		A	B	C	D	
QHTC1000	1078	48	120	150	3	1744
QHTC1500	1540	48	180	210	3	2387
QHTC2000	2096	48	252	282	4	3164
QHTC2500	2596	60	192	227	4	3397
QHTC3000	3174	60	240	275	4	4106
QHTC3500	3607	60	276	311	4	4547
QHTC4000	4219	72	216	257	4	5666
QHTC4500	4635	72	240	281	4	6148
QHTC5000	5258	72	276	317	4	6870
QHTC6000	6398	84	240	287	4	7387
QHTC7000	7246	84	276	232	4	8225
QHTC8000	8498	96	240	293	6	10651
QHTC9000	9239	96	264	317	6	11426
QHTC10000	10719	96	312	365	6	12957

SECTION 15150 - FLOW METER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Detail Specification of the Master Well Flow Meter

1.3 DEFINITIONS

A. Missouri Department of Natural Resources: Mo~DNR

B. American Water Works Association: AWWA

1.4 SYSTEM DESCRIPTION

A. Flow meter shall be a propeller driven meter, measuring flow in gallons.

1.5 PERFORMANCE REQUIREMENTS

A. The meter shall meet the requirements of AWWA D150 and AWWA Standard C-702.

1.6 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of the flow meter that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Faulty operation of inaccurate meter readings or no readings.
   b. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Period: 1 year from date of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Sensus Flow Meters
   2. Master Meter Inc.
   3. ISTEC Flow Measurement & Control

B. Flow meter shall be sized to agree with piping size and expected flow.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine flow meter for any apparent factory or shipping defects prior to installation.

3.2 FLOW METER INSTALLATION

A. Install flow meter according to manufactures guidelines.

END OF SECTION 15150

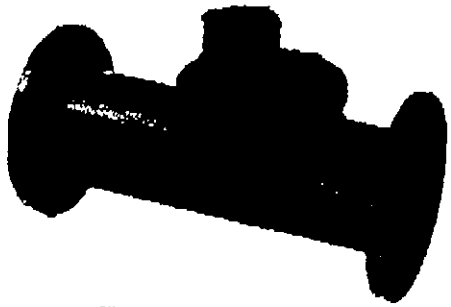
MAINLINE PROPELLER METERS

SENSUS.

MODELS 101/102
150 psi (10 bar) Working Pressure Magnetic Drive Flanged Tube Type

Standard Sealed Register

E-ROFI Register



6" Model 101 Propeller Meter

DESCRIPTION

MODEL: Sensus 101/102 Propeller Meters are primarily intended for accountability measurement of potable and non-potable cold water with flow in one direction only. Registration accuracy is 100% ± 2% of actual thruput within specified normal flow ranges. Because all appropriate parts are sealed for protection, the meters can be used in water containing particulate solids (such as sand), without causing undue wear.

PERFORMANCE: The design of the Sensus 101/102 Propeller Meters permits continuous operation up to the maximum rated flow capacity listed for each size, without affecting long term accuracy or causing undue wear. For accurate measurement, a full flow of water through the meter and stated minimum flow rates are required.

CONSTRUCTION: The meter consists of two basic assemblies—the meter tube body and the meter head assembly. Integral straightening vanes in the meter tube body minimize the swirl upstream of the meter so as to direct the flow evenly to the propeller. The 3" through 12" meter tube bodies are internally and externally protected by a superior fusion-bonded epoxy coating for use in potable water systems. The 14" and larger sizes are protected with an epoxy painted finish. The meter head assembly consists of the propeller, bronze gear box and sealed direct reading register.

MAGNETIC DRIVE: Direct magnetic drive eliminates mechanical gearing normally required to operate propeller meter type registers. A ceramic sleeve-type magnet in the propeller assembly drives a follower magnet located in a one piece, all bronze gear box. This gear box is oil filled and factory sealed to provide lubrication and long life to the register drive shaft.

PROPELLER: The propeller and nut are made of polypropylene and rotate on a ceramic coated stainless steel spindle.

REGISTERS: Sensus Model 101 Propeller Meters come equipped with a sealed direct reading (DR) register with low flow indicator. The Model 102 is equipped with an electronic rate of flow indicator (E-ROFI) register. The E-ROFI register is an hermetically sealed unit that electronically displays and transmits totalization and flow rate data to various Sensus act-pak instrumentation to monitor, control and record volume and rate of flow. Other register options available are the impulse contactor (IC) and high speed pickup (HSP). All registers can be positioned in any of four directions for reading ease. Refer to bulletin E-1116 for HSP and bulletin E-1110 for the E-ROFI register.

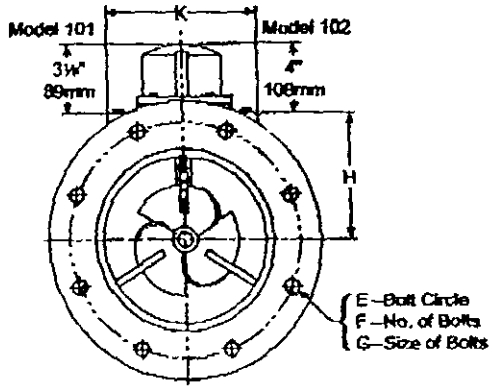
INSTALLATION: Sensus Propeller Meters can be installed in a horizontal, vertical or inclined position. Valves, fittings or other equipment that might create flow turbulence should be positioned at least 5 pipe diameters upstream of the meter and no less than 3 pipe diameters downstream.

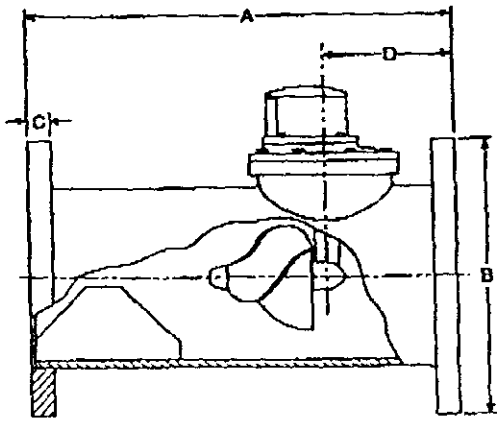
MAINTENANCE: The meter head assembly can be removed, repaired and/or replaced without disturbing the meter tube body in line. A spare meter head assembly can be utilized in the event maintenance is required. Cover plates are also available for maintaining service or flushing of lines when the meter head assembly is removed. Factory testing, repair and meter head assembly exchange programs are available.

SPECIFICATIONS

SERVICE	Measurement of cold water (potable and non-potable) up to 100°F (38°C) with flow in one direction only.
OPERATING RANGE	Continuous Flows: Refer to the chart on next page Intermittent Flows: 25% over the maximum rated capacity of any given size.
ACCURACY	100% ± 2% of actual thruput
LOW FLOW	Refer to the chart on next page
MAXIMUM OPERATING PRESSURE	150 psi (10 bar)
FLANGE	3" Size: Round, AWWA 150 Class 4"-12" Sizes: Round, AWWA Class D 14"-36" Sizes: Round, AWWA 150 Class
REGISTER	Hermetically Sealed Direct Reading Register with Low Flow Indicator
METER REGISTRATION	Standard: Six digit, straight reading type with Low Flow Indicator. Full 3" dial face with 100 division increments and a center sweep hand. E-ROFI: Twin six digit, LCD totalizer and rate of flow display. Powered by a "C" size lithium battery factory sealed in an hermetically sealed register. Register replacement is recommended every five (5) years.
MATERIALS—METER TUBE BODY	3" and 4" Size: Ductile Iron 6"-36" Sizes: Fabricated Steel
STRAIGHTENING VANES	Fabricated Steel
COATINGS	3"-12" Sizes: Fusion-Bonded Epoxy 14"-36" Sizes: Epoxy Paint
METER HEAD	Ductile Iron
PROPELLER AND NUT	Polypropylene
PROPELLER SPINDLE	Ceramic Coated Stainless Steel
GEAR HOUSING	One Piece Cast Bronze
TRIM	Stainless Steel
MAGNETS	Ceramic

Models 101 and 102
150 psi (10 bar)





Meter Size	Low Flow GPM m^3/h ①	Normal Range GPM m^3/h ②	Dimensions A in mm	B in mm	C in mm	D in mm	E in mm	F #	G in mm	H in mm	K in mm	Shipping Weight Pounds kg
3" DN 80mm	80 GPM 18.2 m^3/h	100-250 GPM 23-57 m^3/h	16" 406mm	7-1/2" 190mm	3/4" 19mm	6-1/2" 165mm	6" 152mm	4	5/8" 16mm	3-3/8" 86mm	5" 127mm	70 lbs. 32 kg
4" DN 100mm	82 18.6	125-500 28-114	18" 457mm	9" 229mm	5/8" 16mm	7-1/2" 190mm	7-1/2" 190mm	8	5/8" 16mm	3-7/8" 99mm	7-1/2" 190mm	85 lbs. 39 kg
6" DN 150mm	180 36.3	220-1200 50-273	22" 559mm	11" 279mm	11/16" 17mm	9" 229mm	9-1/2" 241mm	8	3/4" 19mm	5" 127mm	9" 229mm	115 lbs. 52 kg
8" DN 200mm	190 43.2	250-1650 57-375	24" 610mm	13-1/2" 343mm	11/16" 17mm	9" 229mm	11-3/4" 298mm	8	3/4" 19mm	6" 152mm	9" 229mm	150 lbs. 68 kg
10" DN 250mm	260 59.0	330-2500 75-568	26" 660mm	16" 406mm	11/16" 17mm	10" 254mm	14-1/4" 362mm	12	7/8" 22mm	7-3/8" 187mm	11" 279mm	200 lbs. 91 kg
12" DN 300mm	275 62.4	360-3500 80-795	28" 711mm	19" 483mm	13/16" 21mm	10" 254mm	17" 432mm	12	7/8" 22mm	8-3/8" 213mm	11" 279mm	295 lbs. 132 kg
14" DN 350mm	350 79.5	450-4500 102-1022	42" 1067mm	21" 533mm	1-3/8" 35mm	12" 305mm	18-3/4" 476mm	12	1" 25mm	9-1/4" 235mm	13-1/2" 343mm	450 lbs. 204 kg
16" DN 400mm	450 102.2	550-5500 125-1249	48" 1219mm	23-1/2" 597mm	1-7/16" 37mm	12" 305mm	21-1/4" 504mm	16	1" 25mm	10-1/4" 260mm	13-1/2" 343mm	550 lbs. 249 kg
18" DN 450mm	550 124.9	752-7250 165-1647	54" 1372mm	25" 635mm	1-9/16" 40mm	15" 381mm	22-3/4" 578mm	16	1-1/8" 29mm	11-5/8" 295mm	13-1/2" 343mm	620 lbs. 281 kg
20" DN 500mm	700 159.0	850-9000 193-2044	60" 1524mm	27-1/2" 699mm	1-11/16" 43mm	15" 381mm	25" 635mm	20	1-1/8" 29mm	12-5/8" 321mm	13-1/2" 343mm	820 lbs. 372 kg
24" DN 600mm	1000 227.1	1300-13000 250-2502	72" 1829mm	32" 813mm	1-7/8" 48mm	18" 457mm	29-1/4" 749mm	20	1-1/4" 32mm	12-5/8" 321mm	13-1/2" 343mm	1000 lbs. 454 kg
30" DN 750mm	1600 363.4	2100-18000 477-4224	84" 2123mm	38-3/4" 984mm	2-1/8" 54mm	18" 457mm	36" 914mm	28	1-1/4" 32mm	12-5/8" 321mm	13-1/2" 343mm	1150 lbs. 522 kg
36" DN 900mm	2400 545.0	3000-24000 681-5450	96" 2438mm	46" 1168mm	2-5/8" 67mm	20" 508mm	42-3/4" 1086mm	32	1-1/2" 38mm	12-5/8" 321mm	13-1/2" 343mm	1350 lbs. 613 kg

① Low Flow — 95% minimum accuracy
② Intermittent Flow — 25% over maximum rated capacity

SENSUS TECHNOLOGIES, INC.

An Invensys company

Sensus Technologies
P.O. Box 467
450 E. Dallas Avenue
Uniontown, PA 15401
1-800-METER-IT
1-800-638-3748
FAX (Direct to Factory)
Local: (724) 438-7725
Toll Free: 1-800-638-3748
Web site: www.sensus.com
Email: info@sensus.com

AUTHORIZED SENSUS DISTRIBUTOR

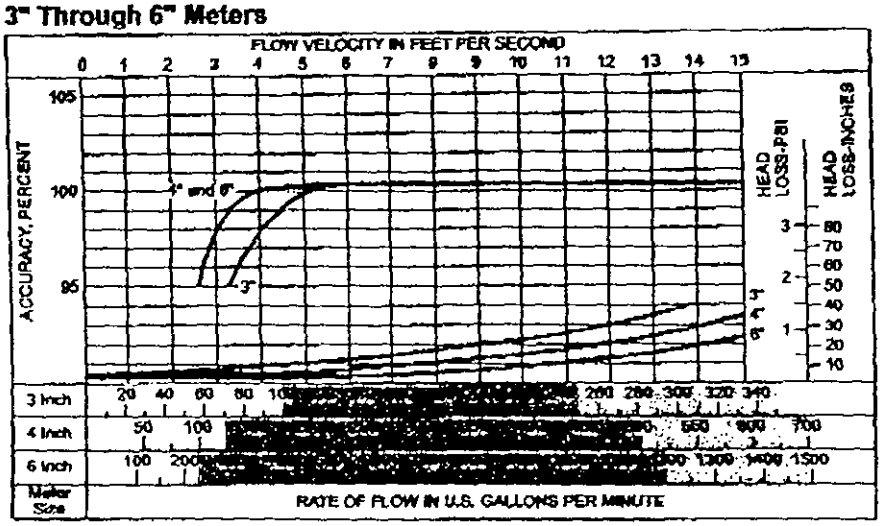
Your Local Sensus Distributor

PROPELLER METERS

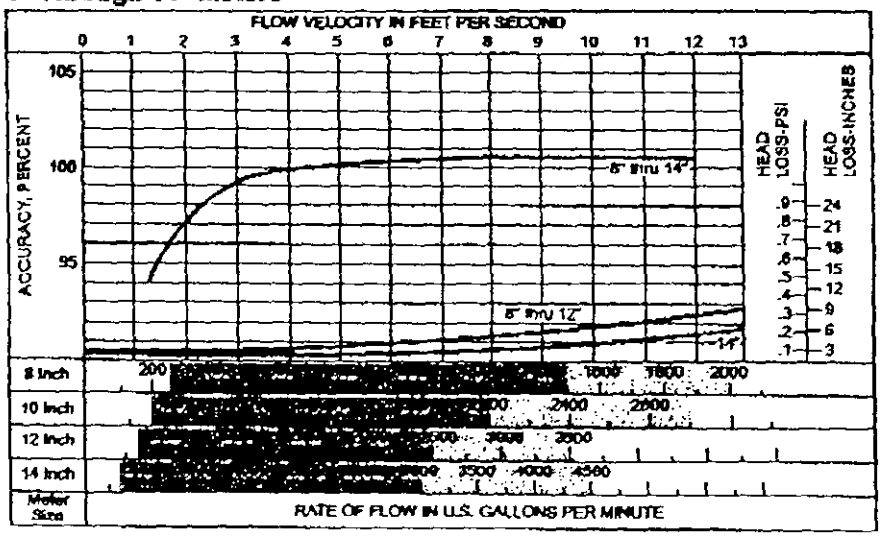
SENSUS.

ACCURACY AND HEAD LOSS CURVES (PAGE 1 OF 2)

3" Through 6" Meters



8" Through 14" Meters



Low Flow
Normal Flow Range
Intermittent Flows

G.P.M. CONVERSION TABLE

1 I.G.P.M. = 1.2 U.S.G.P.M.
1 M.G.D. = 694.4 G.P.M.
1 C.F.S. = 448.831 G.P.M.
1 B.P.D. = .02917 G.P.M.
1 Statutory Miner's Inch (No. Calif.) = 11.22 G.P.M.
1 Miner's Inch (So. Calif.) = 8.98 G.P.M.
1 Acre Foot = 325,851 Gallons

SECTION 15444 - BOOSTER PUMP

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes constant-speed, duplex, booster pumps.

1.3 SUBMITTALS

A. Product Data: For each booster pump specified. Include certified performance curves with operating points plotted on curves; and rated capacities of selected models, furnished specialties, and accessories.

B. Shop Drawings: For booster pumps and accessories. Include plans, elevations, sections, details, and attachments to other work.

1. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
2. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Operation and Maintenance Data: For each booster pump to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of packaged booster pumps and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. ASME Compliance: Comply with ASME B31.9 for piping.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

SECTION 15444 - BOOSTER PUMP

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C. ASME Compliance: Comply with ASME B31.9 for piping.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with pump manufacturer's written rigging instructions for handling.

D. One spare pump shall be kept in storage on site in case of pump failure.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 CONSTANT-SPEED, DUPLEX BOOSTER PUMPS

A. Available Manufacturers:

   1. Berkeley/STA-RITE.
   2. F.E Myers.

B. Description: Factory-assembled and -tested, booster pump with pump, piping, valves, sensors, hydro pneumatic tank, and controls mounted on skids or base.

C. System Working-Pressure Rating: 70 psig minimum.

D. Pump: Overhung impeller, close coupled, single stage, end suction, centrifugal. Comply with UL 778 and with HI 1.1-1.2 and HI 1.3.

   1. Pump Construction: Bronze fitted.

      a. Casing: Radially split, cast iron.
      b. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, closed, and keyed to shaft.
      c. Shaft and Shaft Sleeve: Steel shaft, with copper-alloy shaft sleeve.
      d. Seal: Mechanical.

E. Motor: Single speed, with oil-lubricated bearings, unless otherwise indicated; and directly mounted to pump casing. Select motor that will not overload through full range of pump performance curve.

F. Control Valve: Adjustable, automatic, direct-acting pressure regulator on pump discharge.

G. Relief Valve: Adjustable, pressure relief type on pump discharge.

H. Piping: ASTM A 53/A 53M, Schedule 40, galvanized-steel pipe with threaded, cast-iron fittings and threaded joints.

B. Protect bearings and couplings against damage.

C. Comply with pump manufacturer's written rigging instructions for handling.

D. One spare pump shall be kept in storage on site in case of pump failure.

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      c. Shaft and Shaft Sleeve: Steel shaft, with copper-alloy shaft sleeve.
      d. Seal: Mechanical.

E. Motor: Single speed, with oil-lubricated bearings, unless otherwise indicated; and directly mounted to pump casing. Select motor that will not overload through full range of pump performance curve.

F. Control Valve: Adjustable, automatic, direct-acting pressure regulator on pump discharge.

G. Relief Valve: Adjustable, pressure relief type on pump discharge.

H. Piping: ASTM A 53/A 53M, Schedule 40, galvanized-steel pipe with threaded, cast-iron fittings and threaded joints.

I. Valves: Include shutoff valve at each pump suction, and shutoff valve and check valve at each pump discharge.

1. Shutoff Valves: MSS SP-80, Class 125, bronze, rising-stem gate valve or MSS SP-110, 600-psig minimum CWP, bronze ball valve with ends matching piping.
2. Check Valves: Spring- or lever-loaded, MSS SP-80, Class 125, bronze, swing check valve.

J. Sensors: Pressure and flow switches.

K. Dielectric Fittings: Factory-fabricated union assembly; with insulating material isolating joined dissimilar metals to prevent galvanic action and to stop corrosion; rated for 250-psig minimum working pressure at 180 deg F.

L. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembling and testing. Protect flanges, pipe openings, and pump nozzles.

M. Capacity and Characteristics:
1. Discharge Pressure: 70 psig.
2. Shutoff Pressure: 70 psig.
3. Inlet Size: 2 ½-inch NPS.

a. Outlet Size: 2 inch NPS.

b. A pressure gauge shall be located on the discharge piping as shown on the plans.

4. Pump:

a. Capacity: 87 gpm.
b. Total Dynamic Head: 161.3 feet
c. Shutoff Pressure: 70 psig
d. Speed: 3450 rpm.

5. Motor Horsepower: 7.5 hp
6. Electrical Characteristics:

a. Volts: 208-230
b. Phases: Single.
c. Hertz: 60.
d. Full-Load Amperes: 37
e. Minimum Circuit Ampacity: 40

2.3 BOOSTER PUMP CONTROL PANEL

A. A NEMA 3R control panel shall be furnished for the operation of the booster pumps with the following equipment
1. Elapsed time meters for each pump to record the run time of the pump.
2. Event counter to record the total pump starts.
3. Alternator to switch between pumps.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for booster pumps to verify actual locations of connections before booster pump installation.

3.2 BOOSTER PUMP INSTALLATION

A. Install booster pumps level on concrete floor with access for periodic maintenance including removal of pumps, motors, impellers, couplings, and accessories.

1. Do not dismantle packaged booster pumps or remove individual components.

B. Support connected water piping so weight of piping is not supported by packaged booster pumps.

3.3 CONTROL PANEL INSTALLATION

A. Install booster pump control panel in accordance with the manufactures recommendations. Wiring for the panel shall meet all local and state electrical codes.

3.4 CONNECTIONS

A. Connect water piping to booster pumps. Install suction and discharge pipe equal to or greater than size of unit suction and discharge piping.
1. Install shutoff valves on piping connections to each booster pump suction and discharge piping. Install gate valves same size as suction and discharge piping
2. Install union or flanged connections on pump suction and discharge piping at connection to domestic water piping.
3. Install piping adjacent to packaged booster pumps to allow service and maintenance.

B. Ground equipment according to NEC codes."

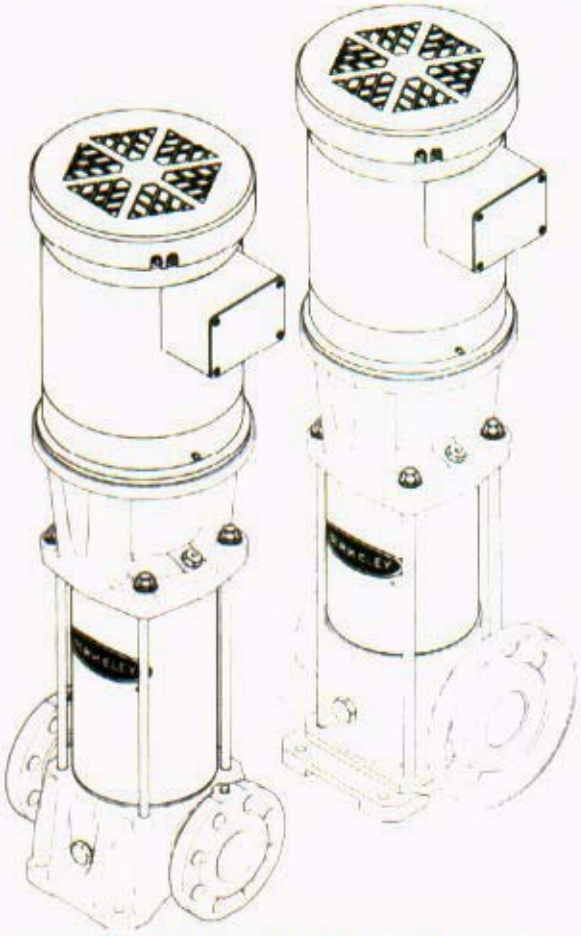
C. Connect wiring according to NEC codes."

3.5 LABELING AND IDENTIFICATION

A. Install identifying equipment markers and equipment signs on booster pumps.

END OF SECTION 15444

Booster



Vertical Multi-stage Pumps - 60 Hz.

BVM - Cast Iron
BVMI - 304 Stainless Steel
BVMX - 316 Stainless Steel

CATALOG – June 2006

Models	Flow Series	HP Range	GPM
BVM/BVMI/BVMX	2	1/2 – 5	1 – 20
BVM/BVMI/BVMX	4	1/2 – 7.5	3 – 40
BVM/BVMI/BVMX	8	3/4 – 15	5 – 65
BVM/BVMI/BVMX	16	5 – 25	8 – 115
BVM	32	3 – 40	15 – 215

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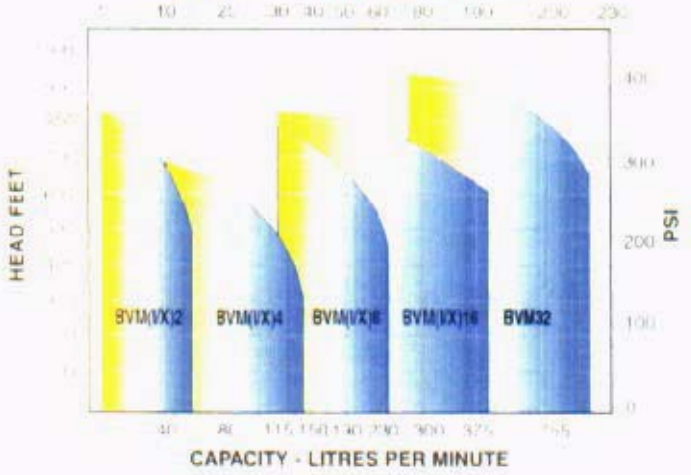
VERTICAL MULTI-STAGE PERFORMANCE



RELAX.
IT'S A BERKELEY™

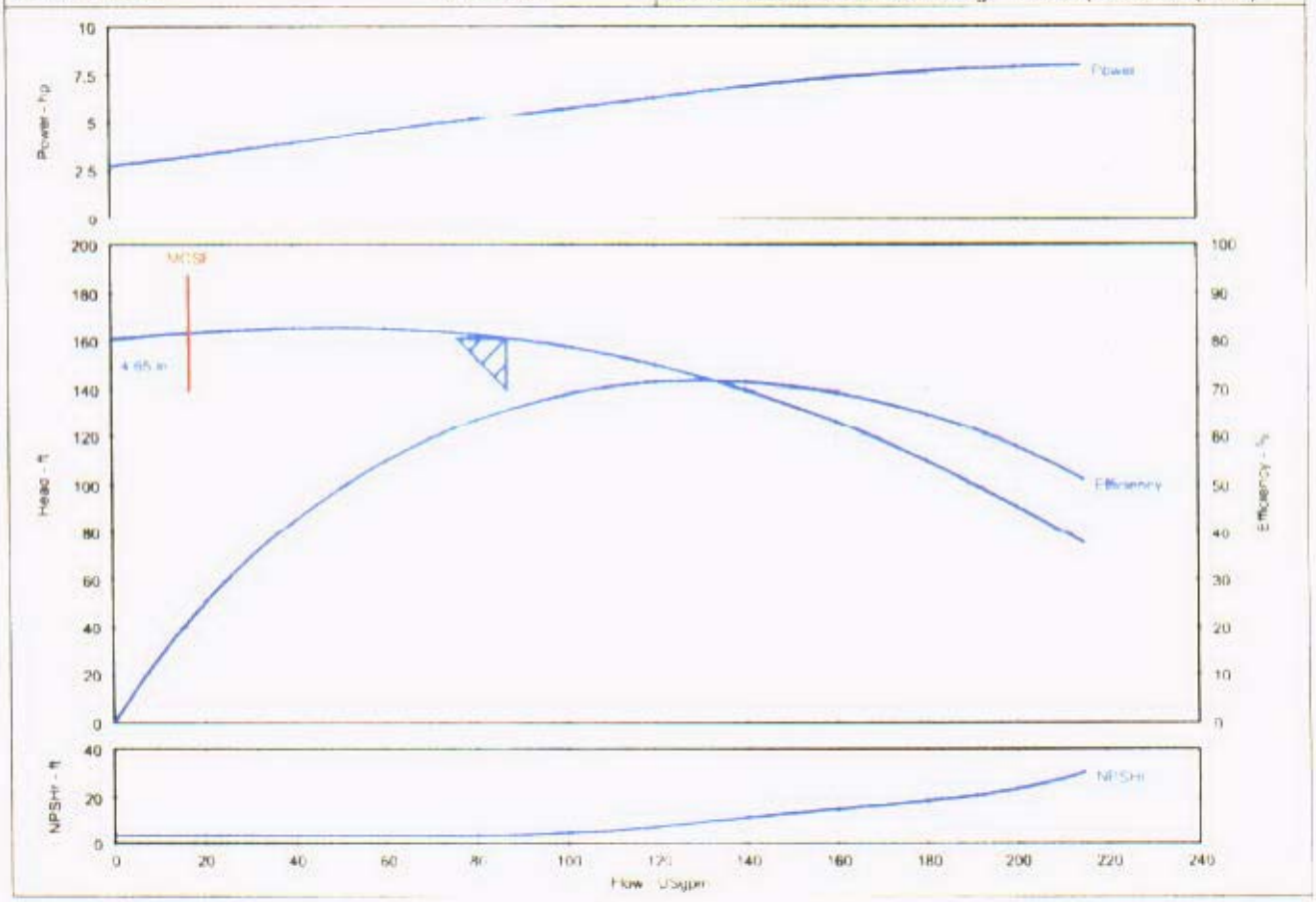
Pentair Water

Booster

Pump Performance Datasheet

Customer	:	Quote number	:
Customer reference	:	Pump size	: BVM32-2
Item number	:	Stages	: 2
Service	:	Based on curve number	: BVM32-2
Quantity of pumps	: 1	Date last saved	: 23 Nov 2009 11:32 AM

Operating Conditions		Liquid	
Flow, rated	87.00 USgpm	Liquid type	: --Water
Head, rated (requested)	161.0 ft	Additional liquid description	:
Head, rated (actual)	161.3 ft	Solids diameter, max	: 0.00 in
Suction pressure, rated / max	0.00 / 0.00 psi.g	Temperature, max	: 68.00 deg F
NPSH available, rated	Ample	Fluid density, rated / max	: 0.998 / 0.998 SG
Frequency	60 Hz	Viscosity, rated	: 1.00 cP
Performance		**Material**	
Pump speed, rated	3,450 rpm	Material requested	: Auto
Impeller diameter, rated	4.65 in	Material selected	: Not specified
Impeller diameter, maximum	4.65 in	**Pressure Data**	
Impeller diameter, minimum	4.65 in	Maximum working pressure	: 71.57 psi.g
Efficiency	65.70 %	Maximum allowable working pressure	: 360.0 psi.g
NPSH required / margin required	4.51 / 0.00 ft	Maximum allowable suction pressure	: N/A
Ns (imp. eye flow) / Nss (imp. eye flow)	1,574 / 7,150 US Units	Hydrostatic test pressure	: N/A
MCSF	17.00 USgpm	**Driver & Power Data**	
Head, maximum, rated diameter	165.4 ft	Driver sizing specification	: Rated power
Head rise to shutoff	N/A %	Margin over specification	: 0.00 %
Flow, best eff. point (BEP)	129.4 USgpm	Service factor	: 1.15 (used)
Flow ratio (rated / BEP)	67.24 %	Power, hydraulic	: 3.54 hp
Diameter ratio (rated / max)	100.00 %	Power, rated	: 5.39 hp
Head ratio (rated dia / max dia)	99.80 %	Power, maximum, rated diameter	: 8.00 hp
Cq/Ch/Ce [ANSI/HI 9.6.7-2004]	1.00 / 1.00 / 1.00	Minimum recommended motor rating	: 7.50 hp / 5.59 kW (Fixed)
Selection status	Acceptable		



BERKELEY Pumps / Pentair Water 293 Wright Street Delavan, Wisconsin 53115
phone: 1-888-237-5353 fax: 1-800-426-9446

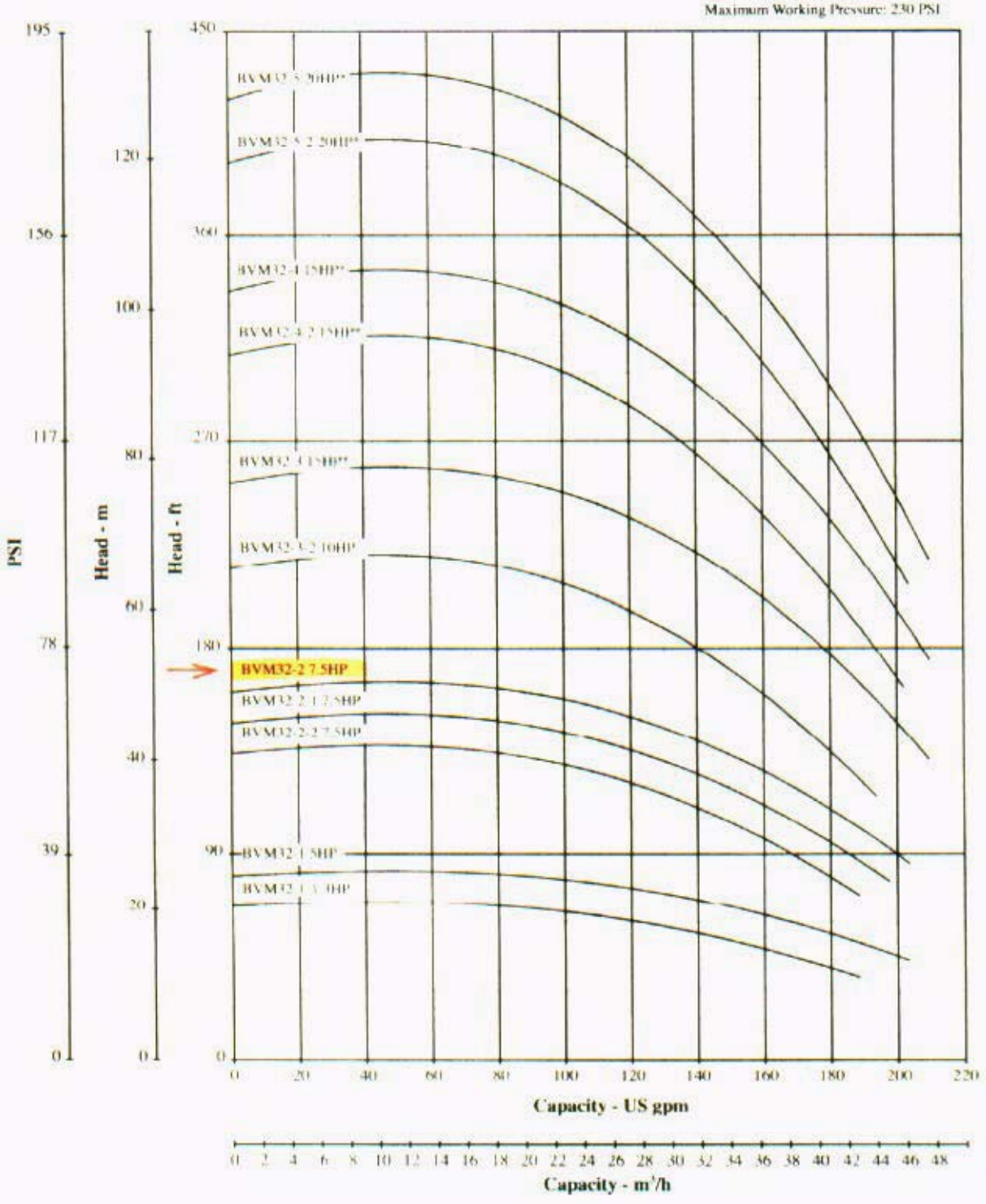
BVM32 SERIES

Booster

Performance Curves – BVM32 Series

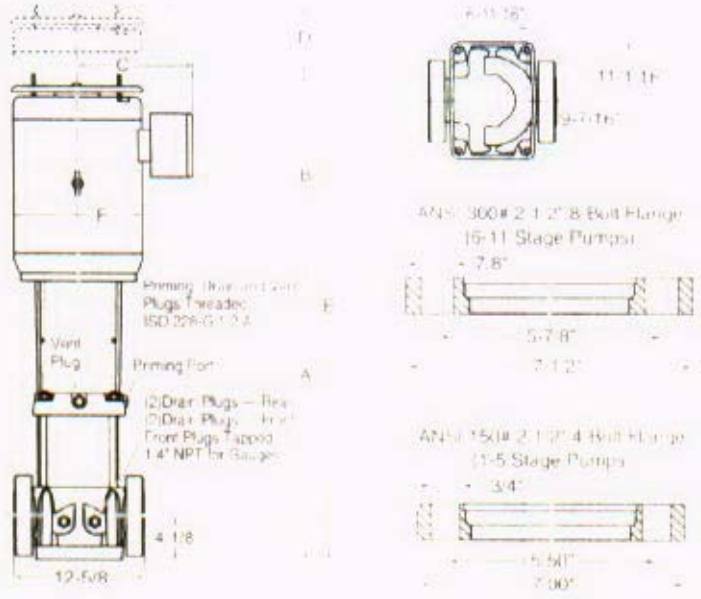
3520 RPM*
3450 RPM

Based on Fresh Water @ 68 F.
Maximum Working Pressure: 230 PSI



BVM32 SERIES

Cast Iron Construction



Technical Information

MINIMUM PUMPING RATES:
Up to 175° F - 15 GPM
175° F to 250° F - 35 GPM

FLOW RANGE: 15 - 215 GPM

MINIMUM SUCTION PIPE SIZES:
2-1/2" Nominal Diameter, Schedule 40 Pipe

MAXIMUM AMBIENT TEMPERATURE: 104° F

LIQUID TEMPERATURE RANGE: 15° F to 250° F

MOTOR OPTIONS: TEFC or ODP
Single or Three Phase
For other options, consult factory

CONSTRUCTION MATERIALS: See Page 28

Dimensions and Specifications – BVM32 Series

Model Number	HP	Motor S.F.	Ph	Volts	Frame Size	Disc. Size	Suc. Size	Dimension in Inches*					
								A	B	C	D	E	F
BVM32-1-1	3	1.15	1	208-230	182TC	2-1/2	2-1/2	22.74	13.63	6.88	2.88	39.24	8.50
BVM32-1-1	3	1.15	3	208-230/460	182TC	2-1/2	2-1/2	22.74	13.63	6.88	2.88	39.24	8.50
BVM32-1	5	1.15	1	208-230	184TCZ	2-1/2	2-1/2	22.74	15.25	8.00	3.38	41.37	10.63
BVM32-1	5	1.15	3	208-230/460	213TC	2-1/2	2-1/2	22.74	15.25	8.00	3.38	41.37	10.63
BVM32-2-2	7.5	1.15	1	208-230	213TC	2-1/2	2-1/2	27.49	15.25	8.00	3.38	46.12	10.63
BVM32-2-2	7.5	1.15	3	208-230/460	213TC	2-1/2	2-1/2	27.49	15.25	8.00	3.38	46.12	10.63
BVM32-2-1	7.5	1.15	1	208-230	213TC	2-1/2	2-1/2	27.49	15.25	8.00	3.38	46.12	10.63
BVM32-2-1	7.5	1.15	3	208-230/460	213TC	2-1/2	2-1/2	27.49	15.25	8.00	3.38	46.12	10.63
BVM32-2	**7.5**	**1.15**	**1**	**208-230**	**213TC**	**2-1/2**	**2-1/2**	**27.49**	**15.25**	**8.00**	**3.38**	**46.12**	**10.63**
BVM32-2	7.5	1.15	3	208-230/460	213TC	2-1/2	2-1/2	27.49	15.25	8.00	3.38	46.12	10.63
BVM32-3-2	10	1.15	1	208-230	215TC	2-1/2	2-1/2	30.24	16.38	8.75	3.38	49.99	10.63
BVM32-3-2	10	1.15	3	208-230/460	215TC	2-1/2	2-1/2	30.24	16.38	8.75	3.38	49.99	10.63
BVM32-3	15	1.15	3	208-230/460	254TC	2-1/2	2-1/2	30.24	19.63	9.50	4.25	54.12	13.00
BVM32-4-2	15	1.15	3	208-230/460	254TC	2-1/2	2-1/2	33.00	19.63	9.50	4.25	56.88	13.00
BVM32-4	15	1.15	3	208-230/460	254TC	2-1/2	2-1/2	33.00	19.63	9.50	4.25	56.88	13.00
BVM32-5-2	20	1.15	3	230/460	254TC	2-1/2	2-1/2	35.75	21.75	9.13	4.00	61.50	11.50
BVM32-5	20	1.15	3	230/460	256TC	2-1/2	2-1/2	35.75	21.75	9.13	4.00	61.50	11.50
BVM32-6-2	25	1.15	3	230/460	284TSC	2-1/2	2-1/2	38.51	21.75	9.13	3.25	63.51	13.00
BVM32-6	25	1.15	3	230/460	284TSC	2-1/2	2-1/2	38.51	21.75	9.13	3.25	63.51	13.00
BVM32-7-2	25	1.15	3	230/460	284TSC	2-1/2	2-1/2	41.25	21.75	9.13	3.25	66.25	13.00
BVM32-7	30	1.15	3	230/460	284TSC	2-1/2	2-1/2	41.85	22.94	13.11	3.25	67.44	14.88
BVM32-8-2	30	1.15	3	230/460	284TSC	2-1/2	2-1/2	44.02	22.94	13.11	3.25	70.21	14.88
BVM32-8	30	1.15	3	230/460	284TSC	2-1/2	2-1/2	44.02	22.94	13.11	3.25	70.21	14.88
BVM32-9-2	40	1.15	3	230/460	286TSC	2-1/2	2-1/2	46.78	22.94	13.13	3.25	72.97	14.91
BVM32-9	40	1.15	3	230/460	286TSC	2-1/2	2-1/2	46.78	22.94	13.13	3.25	72.97	14.91
BVM32-10-2	40	1.15	3	230/460	286TSC	2-1/2	2-1/2	49.53	22.94	13.13	3.25	75.72	14.91
BVM32-10	40	1.15	3	230/460	286TSC	2-1/2	2-1/2	49.53	22.94	13.13	3.25	75.72	14.91
BVM32-11-2	40	1.15	3	230/460	286TSC	2-1/2	2-1/2	52.29	22.94	13.13	3.25	78.48	14.91

* Measurements represent the largest number possible for each model using standard efficiency motors.

SECTION 15862 - OIL-LESS AIR COMPRESSOR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Oil-Less Air Compressor

1.3 DEFINITIONS

A. Missouri Department of Natural Resources: Mo~DNR

B. American Water Works Association: AWWA

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Oil-Less Air Compressor:

a. Thomas Ultra Air-Pac Compressor

b. Charge Air, Pacific Hydro Products

2.2 COMPRESSOR REQUIREMENTS

A. Compressor Requirements
1. Motor
   a. 1 hp or larger
   b. 120 volt single phase
   c. UL listed
2. Compressor and Air Tank
   a. Compressor shall deliver 2.85 cfm @ 90 psi
   b. Tank shall be a minimum of 4 gallons

c. Tank shall meet all ASME Pressure Vessel Codes
d. Tank Shall be Equipped with a 140 psi ASME rated safety valve

B. Charge Air
1. Self Contained Oil-less Compressor
a. 115-volt single phase
b. Internally controlled

PART 3 - EXECUTION

3.1 COMPRESSOR INSTALLATION

A. The compressor shall be mounted as shown on the drawings. Compressor may be mounted on a bench or a shelf capable of supporting the weight of the compressor.

B. The Charge Air system shall be mounted to the tank according to manufactures recommendations.

3.2 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Air Solenoid Valve shall meet the requirements of the controller and be installed in the air line to the Hydropneumatic Tank.

END OF SECTION 15862

CHARGE AIR

Universal Aircharging System for Hydropneumatic Tanks

- Dual Voltage System (120–240 VAC)
- Auto Ranging Solid State Liquid Level Control
- Oil-less Long Life Compressor
- Adjustable Pressure Switch (40–120 PSI)
- One Year Warranty

CHARGE AIR Standard Features...

Charge *Air* is an entirely self-contained dual voltage air charging system. All components are mounted on a corrosion resistant gold zinc plated base using stainless steel fasteners and enclosed within a heavy gauge high density polyethylene, weatherproof outer shell. The protected components include a long life oil-less compressor, auto ranging solid state liquid level control with isolated electrode circuit and time delay and an adjustable 40 to 120 P.S.I. pressure switch.

CHARGE AIR Operation...

Charge *Air* utilizes three primary components: a liquid level switch, a pressure switch, and an air compressor. Through an electrode suspended into the tank from the Charge Air system the liquid level control continuously monitors the water level of the tank. Simultaneously the pressure switch monitors the air pressure in the tank. When the water level is above the electrode and the air pressure in the tank drops below its setting the compressor will start and continue to run until the proper air pressure is reached or the water level drops below the electrode. This constant monitoring guarantees that the optimum air charge is maintained.

CHARGE AIR MFG by Pacific Hydro Products, Grass Valley, CA • (888)747-3257 • Fax (888)865-7325

CHARGE AIR

CHARGE AIR
Pacific Hydro Products

Installation Instructions

Charge Air Model CA2000 Air Volume Control

1. Attaching The Water Level Probe—The bottom of the probe should hang half way from the top of the tank and tank and the center of the outlet pipe at the bottom. Measure this distance, divide by two, and add 4 inches. Cut the white probe wire to this length, and strip 1/2" of insulation from the end of the wire. Twist the wire strands into a tight bundle, and connect the probe wire to brass connector inside the coupling on the ***Charge Air*** base by sliding the stranded bundle into the side of the brass connector and securing it with the stainless steel screw provided. Use caution not to over tighten the screw as it might cut the wire strands. Gently pull on the wire to confirm a sound attachment.

2. Mounting Charge Air to The Tank—***Charge Air*** should be located near the end of the tank if possible for ease of installation and servicing, but not over the water inlet pipe where waves might disturb the probe readings. Attach ***Charge Air*** using a 2" steel pipe nipple 3" long. Use a good thread sealing compound or Teflon tape to assure an air tight seal. The vibration damper rod must be adjusted so it is snug against the tank, and line up with the tank centerline if on a horizontal tank.

3. Connecting the Electrical Power—The ***Charge Air*** operates on either 115,208, or 230 volts. The motor is factory wired for 115 volts, so if higher voltage is used the jumpers in the back of the motor must be moved according to the motor name plate diagram. The water level control electronic module is auto ranging, which means it will operate on either 115, 208, or 230 volts without any adjustment. Power to the ***Charge Air*** should be a separately fused 15 amp circuit. Because ***Charge Air*** circuitry is surge protected, it can be powered from the pump control panel. Since it operates independently of the pump, it should be connected between the disconnect and the pump contractor.

4. Adjusting the Pressure Switch—***Charge Air*** pressure switch cut-out must be set 5 PSI below the pump pressure switch cutout setting. For instance, if the pump pressure switch is set at 40-60, the Charge Air pressure switch must be set at 55 PSIG. The ***Charge Air*** switch is factory set at 45 PSIG, making it suitable, as shipped, for a pump pressure switch setting of 30-50. Any other pump pressure setting requires an adjustment of the ***Charge Air*** Pressure Switch. ***(Note—The minimum set point on the Charge Air pressure switch is 40 PSI, so the minimum system pressure for which Charge Air is suitable is 25-45.)*** The Charge Air pressure switch has a thumb wheel which is used to adjust it's pressure setting. The indicator on the front to the pressure switch gives only a ball park indication of the cutout pressure, so a pressure gauge must be used to make the final adjustments. Before adjusting the setting, drain enough water out of the tank to make the pump cycle. Watch the pressure gauge and note the exact pressure reading when the pump shuts off at the end of the pumping cycle. Adjust the ***Charge Air*** pressure switch to turn the compressor off 5 PSIG below this Pump cutoff reading. To increase the compressor cutout setting, turn the thumb wheel until the compressor turns on and slowly increase the setting until the desired cutout pressure is achieved. When adjusting the setting, make sure there is enough water in the tank to contact the probe so the compressor will run. Some means of bleeding air out of the tank without changing the water level makes setting the compressor cutout pressure much quicker and more accurate. ***(Note—Should the compressor not start as expected, remember the 15 second on-delay timer built into the water level control circuitry to prevent the it from short cycling due to waves in the tank.)***

Pacific Hydro Products, Inc. Box 1697, Grass Valley, CA 95945 • Phone 888 747-3257 • FAX 888 865-7325

SECTION 15867 - ELECTRIC HEATER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Wall Mount Electric Heater

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Electric Wall Heater

a. Qmark

B. Heater Requirement
1. 3600/4800 watts; 240 volt
2. Wall mounted minimum 36-inches above the finish floor.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Wall Heater shall be mounted according to the manufactures requirements. Wiring to the heater shall meet all NEC codes and local building codes.

END OF SECTION 15867

No. 5E176 [A] No. 5E177

[A] TAMPER-RESISTANT HEATERS

Tamper-resistant, commercial-grade construction features are ideal for small entryways, lobbies, corridors, stairwells, rest rooms, churches, schools, offices, stores and other public buildings where supplementary heat is required. Integral thermostat is tamper-resistant and adjustable only by inserting narrow blade screwdriver through front bar grille of heater. Permanently lubricated totally enclosed fan motor provides long life and low maintenance; gently distributes 100 CFM warm air throughout room area. Contemporary heavy-duty 16-gauge steel bar grille available in bronze brown baked enamel finish and satin finished aluminum frame or Navajo white unit and frame. Recess mounts in standard 2" x 4" stud walls. Housing measures 14⅝"W x 18⅜"H x 3⅝"D. Use No. 5E188 (Bronze Brown) or No. 5E189 (Northern White) frames for surface mounting applications.

SURFACE MOUNTING FRAMES FOR TAMPER-RESISTANT HEATERS

For surface installation on brick, concrete block, wood, and plaster walls. Frame extends 3½". Screws and mounting hardware included.

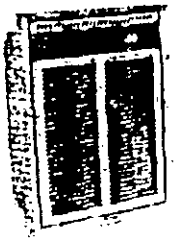
No. 5E188. Bronze brown frame. QMark brand (AWH-SM). Shpg. wt. 4.0 lbs. List $58.48. Each $48.55

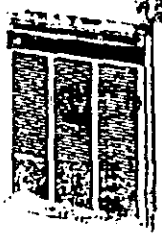
No. 5E189. Navajo white frame. QMark brand (FRA-SM). Shpg. wt. 4.0 lbs. List $58.48. Each $48.55

QMARK

BUILT-IN ELECTRIC WALL HEATERS FEATURE:

- Heavy-duty steel finned metal sheath heating element
- Built-in fan delay switch energizes fan motor only after elements are heated
- Integral thermostat for quick installation
- Motors are totally enclosed, impedance protected with permanently lubricated bearings
- For use in applications where energy management is critical





No. 3UF58 [B] No. 3UF60

Repair Parts Available
1-800-323-0620

[B] ARCHITECTURAL / COMMERCIAL GRADE HEATERS

Highly styled design is ideal for supplementary heating of offices, reception rooms, game rooms, family rooms and similar light-duty commercial and residential applications. Rugged stamped steel front covers attractively finished in Northern White baked enamel with a brushed gold and silver trimmed face plate. Hole plugs provided for tamper resistant installations. Separate tamper resistant front cover, in Northern White finish available for Nos. 3UF59 thru 3UF63. Nos. 3UF59 thru 3UF63 have a built-in fan only switch. Nos. 3UF60, 3UF61, 3UF59, 3UF62, and 3UF63 grille dimensions are 19¾"H x 15¾"W x 1½"D; Openings are 18¼"H x 14¾"W x 3¾"D. No. 3UF58 grille dimensions are 14¾"H x 11¾"W x 1¼"D; Opening is 12¾"H x 9¾"W x 3¾"D. QMark.

SURFACE MOUNTING FRAMES

No. 4TM74 Surface Mounting Frame. QMark brand (CWHSM1) used with No. 3UF58 only. Shpg. wt. 2.0 lbs. List $59.66. Each $46.40

No. 4TM75 Surface Mounting Frame. QMark brand (FZSM) used with Nos. 3UG12, 3UG13 and 3UG11 on page 3458. Shpg. wt. 2.0 lbs. List $44.89. Each $34.90

No. 3UF65 Surface Mounting Frame. Use with Nos. 3UF59, 3UF60, 3UF61, 3UF62 and 3UF63. Frame extends 3½". QMark brand (CWH3-SM). Shpg. wt. 2.0 lbs. List $57.66. Each $46.20

No. 3UF64 Surface Mounting Frame. 1" Deep surface mounting sleeve for semi-recessed installation. QMark brand (CWH3S-1). Shpg. wt. 2.0 lbs. List $57.66. Each $46.20

No. 3UF65 Surface Mounting Frame. 2" Deep Surface mounting sleeve for semi-recessed installation. QMark brand (CWH3S-2). Shpg. wt. 2.0 lbs. List $57.66. Each $46.20

No. 3UG58 Security Front Cover. For Nos. 3UF59 through 3UF63 and 3UG55 through 3UG57 (sold on page 3458). 14-Gauge steel. Northern White finish. QMark brand (UFKSFC). Shpg. wt. 6.0 lbs. List $88.64. Each $59.90

Key	Heater Description	Watts	BtuH	Volts 60Hz	Amps	Enamel Finish	Q Mark Model	Stock No.	List	Each	Shpg. Wt.
A	Tamper-Resistant	1500	5120	277	5.5	Brown	AWH-4157	5E176	$450.16	$342.25	25.0
		1500	5120	277	5.5	White	AWH-4157MG	5E177	450.16	342.25	25.0
		2000	6842	208	10.0	Brown	AWH-4208	5E178	450.16	342.25	25.0
		2000	6842	208	10.0	White	AWH-4208MG	5E179	450.16	342.25	25.0
		2000	6842	240	8.5	Brown	AWH-4204	5E180	450.16	342.25	25.0
		2000	6842	240	8.5	White	AWH-4204MG	5E181	450.16	342.25	25.0
		4000	13,650	208	19.5	Brown	AWH-4408	5E182	515.53	391.75	25.0
		4000	13,650	208	19.5	White	AWH-4408MG	5E183	515.53	391.75	25.0
		4000	13,650	240	16.7	Brown	AWH-4404	5E184	515.53	391.75	25.0
		4000	13,650	240	16.7	White	AWH-4404MG	5E185	515.53	391.75	25.0
		4000	13,650	277	14.5	Brown	AWH-4407	5E186	515.53	391.75	25.0
		4000	13,650	277	14.5	White	AWH-4407MG	5E187	515.53	391.75	25.0
B	Architectural/ Commercial Grade	1500/750 2000/1000	5120/2560 6826.2113	208/240	5.2/3.6 6.3/4.2	White	CWH2202	3UF58	191.06	136.10	13.0
		3000/4000	10,239/13,652	208/240	14.5/16.7	White	CWH3404	3UF60	379.00	269.75	22.0
		3000/4000	10,239/13,652	240/277	12.5/14.5	White	CWH3407	3UF61	379.00	269.75	22.0
		3000	10,239	277	10.8	White	CWH3307	3UF59	379.00	269.75	22.0
		3600/4800	10,287/16,382	208/240	14.3/20.0	White	CWH3504	3UF62	379.00	269.75	22.0
		3600/4800	12,287/16,382	240/277	16.0/17.3	White	CWH3507	3UF63	379.00	269.75	22.0

SECTION 15911 – WELL SYSTEM CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Ground Storage Tank Water Level Controller
2. Booster Pump Controller
3. Hydropneumatic Pressure Tank Air Controller

1.3 DEFINITIONS

A. Missouri Department of Natural Resources: Mo~DNR

1.4 SUBMITTALS

A. Product Data: For the following:

1. Ground Storage Tank Water Level Controller
2. Booster Pump Controller
3. Hydromaster Pressure Tank air Controller

B. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.

C. Shop Drawings: Installation details for the controller.

D. Shop Drawings: Diagram power, signal, and control wiring.

E. Operation and Maintenance Data: For all listed Controllers to include in emergency, operation, and maintenance manuals.

1.5 ALTERNATE CONTROLLER

A. Master Level Controls
   1. Single Panel Controller
      a. H-172

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of Controller that fail in materials or workmanship within specified warranty period.

   1. Warranty Period: 1 year from date of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. Ground Storage Tank Water Level controller
      a. Ametek: B/W Controls
   2. Booster Pump Controller
      a. Square "D": Pressure Switch Controller
   3. Hydropneumatic Pressure Tank Air Controller
      a. Charge Air "Oil-Less" Air Controller, Model CA2000.

2.2 CONTROLS and FEATURES

A. Ground Storage Tank Water Level Controller features:
   1. Pump Start Electrode
   2. Pump Stop Electrode
   3. Booster Pump low Level Stop Electrode
   4. Contact for Well Pump Motor Starter

B. Booster Pump Control Requirements
   1. Square "D" 50/70 Pressure Switch or Approved substitute.
   2. Contact for Booster Pump Motor Starter

C. Hydropneumatic Pressure Tank Air Controller
   1. Charge Air Model CA2000
   2. 2-inch NPT attachment
   3. 115-volts
   4. Adjustable pressure switch

D. Alternate Master Level Controls H-172
   1. Ground Storage Tank Water Level Controls
      a. Well pump on/off
   2. Booster Pump Controls with low water pump off control.

a. Booster pump on/off, ground storage tank low water off

3. Hydropneumatic Add air control

PART 3 - EXECUTION

3.1 EXAMINATION

A. Contractor shall examine the products upon arrival for any defects or damage during shipping.

3.2 INSTALLATION

A. All Controls shall be installed according to the manufactures guidelines

3.3 CONNECTIONS

A. Connect wiring according to manufactures shop drawings.

END OF SECTION 15910

CHARGE AIR

Pacific Hydro Products

Universal Aircharging System for Hydropneumatic Tanks

- Dual Voltage System (120–240 VAC)
- Auto Ranging Solid State Liquid Level Control
- Oil-less Long Life Compressor
- Adjustable Pressure Switch (40–120 PSI)
- One Year Warranty

CHARGE AIR Standard Features...

Charge *Air* is an entirely self-contained dual voltage air charging system. All components are mounted on a corrosion resistant gold zinc plated base using stainless steel fasteners and enclosed within a heavy gauge high density polyethylene, weatherproof outer shell. The protected components include a long life oil-less compressor, auto ranging solid state liquid level control with isolated electrode circuit and time delay and an adjustable 40 to 120 P.S.I. pressure switch.

CHARGE AIR Operation...

Charge *Air* utilizes three primary components: a liquid level switch, a pressure switch, and an air compressor. Through an electrode suspended into the tank from the Charge Air system the liquid level control continuously monitors the water level of the tank. Simultaneously the pressure switch monitors the air pressure in the tank. When the water level is above the electrode and the air pressure in the tank drops below its setting the compressor will start and continue to run until the proper air pressure is reached or the water level drops below the electrode. This constant monitoring guarantees that the optimum air charge is maintained.

CHARGE AIR MFG by Pacific Hydro Products, Grass Valley, CA • (888)747-3257 • Fax (888)865-7325

CHARGE AIR

CHARGE AIR
Pacific Hydro Products

Installation Instructions

Charge Air Model CA2000 Air Volume Control

1. Attaching The Water Level Probe—The bottom of the probe should hang half way from the top of the tank and tank and the center of the outlet pipe at the bottom. Measure this distance, divide by two, and add 4 inches. Cut the white probe wire to this length, and strip 1/2" of insulation from the end of the wire. Twist the wire strands into a tight bundle, and connect the probe wire to brass connector inside the coupling on the ***Charge Air*** base by sliding the stranded bundle into the side of the brass connector and securing it with the stainless steel screw provided. Use caution not to over tighten the screw as it might cut the wire strands. Gently pull on the wire to confirm a sound attachment.

2. Mounting Charge Air to The Tank—***Charge Air*** should be located near the end of the tank if possible for ease of installation and servicing, but not over the water inlet pipe where waves might disturb the probe readings. Attach ***Charge Air*** using a 2" steel pipe nipple 3" long. Use a good thread sealing compound or Teflon tape to assure an air tight seal. The vibration damper rod must be adjusted so it is snug against the tank, and line up with the tank centerline if on a horizontal tank.

3. Connecting the Electrical Power—The ***Charge Air*** operates on either 115,208, or 230 volts. The motor is factory wired for 115 volts, so if higher voltage is used the jumpers in the back of the motor must be moved according to the motor name plate diagram. The water level control electronic module is auto ranging, which means it will operate on either 115, 208, or 230 volts without any adjustment. Power to the ***Charge Air*** should be a separately fused 15 amp circuit. Because ***Charge Air*** circuitry is surge protected, it can be powered from the pump control panel. Since it operates independently of the pump, it should be connected between the disconnect and the pump contractor.

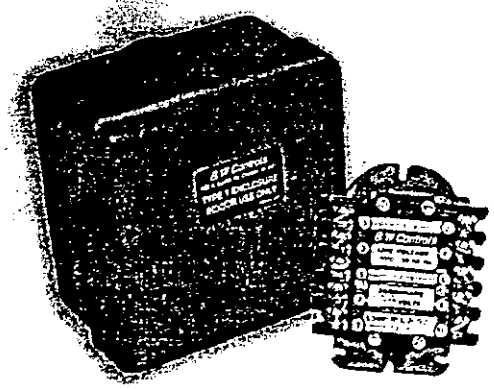
4. Adjusting the Pressure Switch—***Charge Air*** pressure switch cut-out must be set 5 PSI below the pump pressure switch cutout setting. For instance, if the pump pressure switch is set at 40-60, the Charge Air pressure switch must be set at 55 PSIG. The ***Charge Air*** switch is factory set at 45 PSIG, making it suitable, as shipped, for a pump pressure switch setting of 30-50. Any other pump pressure setting requires an adjustment of the ***Charge Air*** Pressure Switch. ***(Note—The minimum set point on the Charge Air pressure switch is 40 PSI, so the minimum system pressure for which Charge Air is suitable is 25-45.)*** The Charge Air pressure switch has a thumb wheel which is used to adjust it's pressure setting. The indicator on the front to the pressure switch gives only a ball park indication of the cutout pressure, so a pressure gauge must be used to make the final adjustments. Before adjusting the setting, drain enough water out of the tank to make the pump cycle. Watch the pressure gauge and note the exact pressure reading when the pump shuts off at the end of the pumping cycle. Adjust the ***Charge Air*** pressure switch to turn the compressor off 5 PSIG below this Pump cutoff reading. To increase the compressor cutout setting, turn the thumb wheel until the compressor turns on and slowly increase the setting until the desired cutout pressure is achieved. When adjusting the setting, make sure there is enough water in the tank to contact the probe so the compressor will run. Some means of bleeding air out of the tank without changing the water level makes setting the compressor cutout pressure much quicker and more accurate. ***(Note—Should the compressor not start as expected, remember the 15 second on-delay timer built into the water level control circuitry to prevent the it from short cycling due to waves in the tank.)***

Pacific Hydro Products, Inc. Box 1697, Grass Valley, CA 95945 • Phone 888 747-3257 • FAX 888 865-7325

AMETEK®

Series 1500 B/W Controls

Induction Control Relays



PRINCIPLE OF OPERATION

A B/W floatless liquid level control system consists of a relay of the proper type, a holder designed to support one or more electrodes or probes in the liquid container, and the corrosion resistant electrodes themselves. In as much as all B/W induction relays are quite similar -- differing only in contact arrangement, the following description of how a 1500-C Relay functions on a pump down control application will serve to explain the design, construction, and operating principles for the entire line.

As shown in diagrams below, the laminated core of the relay is **A** shaped. The primary coil is assembled to the upper bar of the core, and the secondary coil for the electrode is placed on the lower bar. An armature located below the legs of the **A** core is connected to an insulated arm carrying the movable contacts. When the armature is raised, these contacts close or open the motor and electrode circuits, depending upon whether the contacts are normally open or closed. (Contacts shown normally open in this example).

When a source of alternating current is connected to the primary coil at terminals 3 and 4, the primary coil sets up a magnetic flux which -- following the lines of least resistance -- circulates through the shortest path. As shown in Figure 1, this is through the lower bar of the laminated core on which the secondary coil is mounted. This magnetic flux induces a voltage in the secondary or electrode circuit coil. No current can flow in this coil, however, until the circuit is completed between the electrodes. **Thus, the electrode circuit voltage being generated within the relay has no connection with the power line.**

The B/W 1500 induction relay utilizes the liquid as an electrical conductor to complete the secondary circuit between the upper and lower electrodes. Thus, when the liquid contacts the upper electrode, the resulting flow of current in this circuit sets up a bucking action in the lower bar of the core. This action tends to divert lines of magnetic force to the core legs and sets up an attraction that pulls the armature in to contact with the legs, as shown in Figure 2. This armature movement closes the electrode and load contacts.

The lower contacts on 1500-C Relays (terminals 9 and 10) connect the secondary circuit to ground when liquid contacts the upper electrode and act as a holding circuit to maintain the relay in its closed position until the liquid falls below the lower electrode. This holding circuit provides control of the relay over any desired range in the liquid level, depending on the distance between the upper and lower electrodes.

The flow of current through the low energy secondary circuit is very small and varies with the voltage of the secondary coil. The secondary coil is selected to operate over the resistance of the liquid being controlled. Accordingly, since there is a wide range of secondary coils from which to choose, it is important that complete information regarding the nature of the liquid be furnished when ordering B/W induction relays.

1500-C RELAY USED FOR PUMP DOWN CONTROL

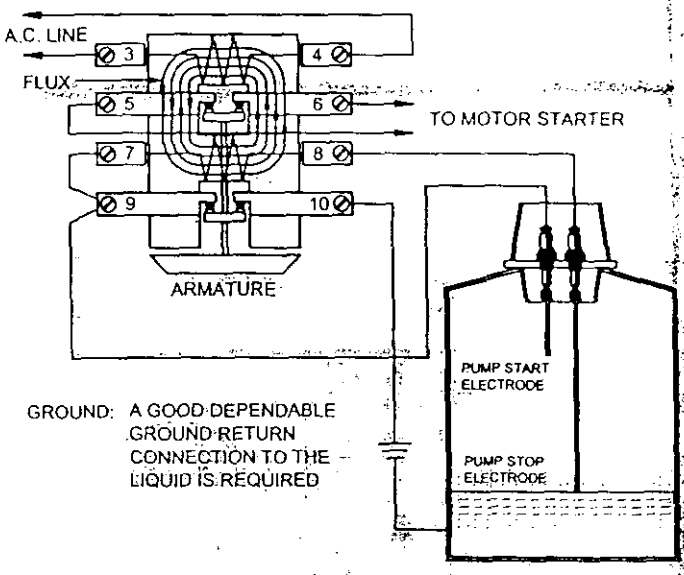


Figure 1 - Secondary coil circuit open; armature down.

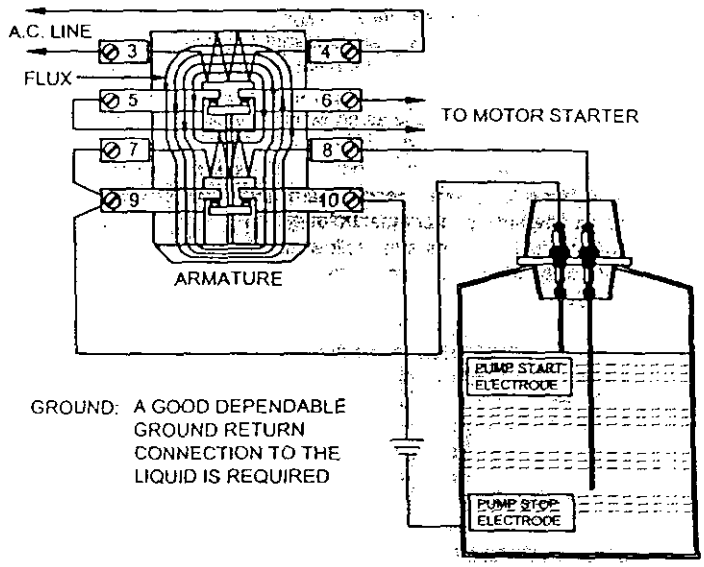
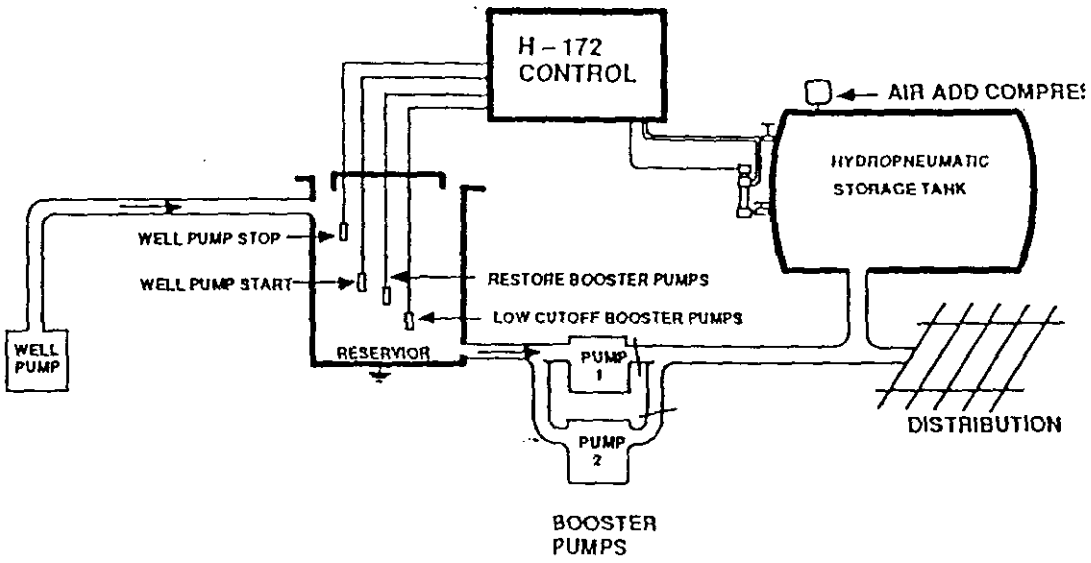


Figure 2 - Secondary coil circuit closed; armature up.

MASTER LEVEL CONTROLS

ALTERNATE CONTROLLER

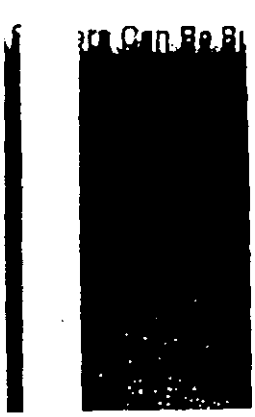
Typical Water System



H– 172 CONTROL

CONTROLS

Well Pump (S)	–	Filling Reservoir
Booster Pumps	–	Supplying System And Storage Tank
Booster Pumps	–	Alternating Sequence
Low Cutoff Of Booster Pumps	–	Prevents Pumping A Dry Reservoir
Air Compressor	–	Supplying Air To Storage Tank



MASTER LEVEL CONTROLS JAN 19

OMASTER CONTROL

e Panels With Motor Control Are Available
robe Assembly Is Furnished With Each Controller

SEPARATE CONTR
PRICE LIST

R		PRESSURE RANGE 5-100PSI			NEM
EL	NUMBER OF PUMPS	CONTROL VOLTAGE	YOUR STARTER COIL CIRCUIT MAX. VOLTS	SPECIAL FORM A	STAND/ FOR
- 1	1	120	240	$ 715.00	$ 66
- 2	1	208/230	240	725.00	69
- 3	1	120	460	765.00	72
- 4	1	460	460	800.00	76
- 1	2	120	240	1060.00	102
- 2	2	208/230	240	1080.00	105
4 - 1	2*	120	240	1210.00	119
4 - 2	2*	208/230	240	1230.00	120
- 1	3	120	240		130
5 - 1	3**	120	240		166

NT		PRESSURE RANGE 5-100PSI		
5 - 1	1	120	240	$ 7
5 - 2	1	208/230	240	7
5 - 1	2	120	240	10
5 - 2	2	208/230	240	10
230 - 1	2*	120	240	12
230 - 2	2*	208/230	240	12

)D & AIR VENT		PRESSURE RANGE 5-100PSI		
36 - 1	1	120	240	$ 9
36 - 2	1	208/230	240	9
46 - 1	2	120	240	12
46 - 2	2	208/230	240	13
239 - 1	2*	120	240	14
239 - 2	2*	208/230	240	14

: PUMP ALTERNATOR **3 PUMP ALTERNATOR

SSORIES MOST USED - MANY OTHERS AVAILABLE F

ntrol test

STATE OF MISSOURI
Jeremiah W. (Jay) Nixon, Governor • Mark N. Templeton, Director
DEPARTMENT OF NATURAL RESOURCES
www.dnr.mo.gov

AR/R1
Holtgrewe Farms, L.L.C.
Review No. 62854-09
PWS ID# MO 6031607

January 26, 2010

CERTIFIED MAIL # 7008 2810 0000 2019 8842
RETURN RECEIPT REQUESTED

Mr. Tony Bequette, Member
Holtgrewe Farms, L.L.C.
109 North Oak Street
Union, Missouri 63084

Dear Mr. Bequette:

We are advising that detailed plans and specifications for Holtgrewe Farms L.L.C., Franklin County, Missouri were submitted by Wunderlich Surveying and Engineering, Inc, consulting engineers, Union, Missouri, on December 7, 2009. Please make reference to Review No. 62854-09 when submitting documents pertinent to this proposal. In order for us to complete our review of the project, please consult with your engineer and respond to the following comments within 30 calendar days from your receipt of this letter:

1. We recommend resizing the water mains from four inches to six inches in order to accommodate the possibility of future fire flow. Fire hydrants can only be installed on water main six inches or larger per Design Guide for Community Water Systems (effective August 29, 2003) section 8.1.2 a.

2. The surface casing should either be grouted between the outside of the casing and the drill hole or it needs to be removed once drilling is completed, per the "Design Guide for Community Water Systems" (effective August 29, 2003) section 3.2.5.5, section 3.2.5.6 and section 3.2.5.11.

3. The steel casing for the well should have either full circumferential welds or threaded coupling joints per Design Guide for Community Water Systems" (effective August 29, 2003) section 3.2.5.6 e. The specifications provided call for solvent-cement joints section 02525-4, Part 3.2.D.4.

4. The casing vent of the well should be at a minimum 1.5 inches in diameter and have an 18 mesh corrosion resistant screen per Design Guide for Community Water Systems (effective August 29, 2003) section 3.2.6.5.

5. Verify that the permanent casing will project at least twelve inches above the well house floor or eighteen inches above the final ground surface per Design Guide for Community Water Systems" (effective August 29, 2003) section 3.2.5.12 a.

6. Provide plans showing the diameters of the drill hole from the twelve inch casing to the bottom of the well. This should document the size of the drill hole for the twelve inch casing, the six inch casing, and after the six inch casing ends to the bottom of the well.

7. Provide detailed specifications showing the procedures to be followed for grouting the well.

8. Provide the height of the overflow from the finished floor of the tank and provide the type of pipe the overflow will be.

9. Provide the head range in the storage tank.

10. Provide the type of pipe of the inlet and the outlet of the storage tank.

11. A chain link security fence must be provided around the perimeter of the storage tank area and well house to provide protection against vandalism, sabotage, terrorist acts, or access by unauthorized personnel.

12. Provide documentation of the continuing operating authority including who the owner of the water facility will be once the subdivision is populated, and who owns (or will own) the land where the well, storage tank, and well house is located. Bylaws should also be provided for the party responsible for the ongoing maintenance, operation, and modernization of the system. There should also be a covenant for the owner of each piece of property assuring them connection to the system if it is available. Also that the incorporated association has authority to lay all necessary water lines for the subdivision.

13. The operational management plan submitted with the project is not sufficient. The plan should outline all operating procedures consistent with maintaining and operating the water facility. This needs to include the type of treatment and degree of automatic control, including the process to be used to identify and implement changes to current procedures and ensure that changes in responsible personnel are reported and implemented. References to other documents and guides are not sufficient.

If it is not possible for you to respond, you may request an extension by letter to Mr. Maher Jaafari, P.E., Chief, Public Drinking Water Permits and Engineering Section, P.O. Box 176, Jefferson City, MO 65102. The request for extension must identify the reasons why the applicant cannot respond within the established time frame and must include a proposed timetable or deadline for response. Extension will only be granted when the request is received within 30 calendar days from your receipt of this letter.

Further action on your submittal awaits your satisfactory response to the above comments. Two copies of the revised plans and specifications should be submitted to this office for further review. If you have any questions, or if we could be of assistance to you, feel free to call us.

Sincerely,

WATER PROTECTION PROGRAM

Kristin Bailey

Kristin Bailey, Environmental Engineer
Public Drinking Water Permits and Engineering Section

KJB:erk

c: Wunderlich Surveying and Engineering
St. Louis Regional Office

WUNDERLICH SURVEYING & ENGINEERING, INC.
20 S. CHURCH STREET • P.O. BOX 536 • UNION, MO 63084
(636) 583-8400 Fax: (636) 583-1810

February 22, 2010

Holtgrewe Farms, L.L.C.
Review No. 62854-09
PWS ID# MO 6031607

Response to DNR Review Letter Dated January 26, 2010

MO DNR Public Drinking Water
P.O. Box 176
Jefferson City, MO 65102

The following comments correspond to the number of each item on the review letter dated January 26, 2010.

1. A dry hydrant will be installed in the subdivision lake to meet the fire flow requirements. The proposed 4 inch water line is for potable water only and will not see any fire flow demand.

2. The surface casing will be temporary and will be removed once drilling is complete. The drawings have been revised.

3. Section 02525-4, Part 3.2.D.4 of the specifications has been revised to reflect either full circumferential welds or threaded coupling joints.

4. The report and drawings have been revised to reflect a 1.5 inch diameter casing vent and #18 mesh corrosion resistant screen.

5. The drawings have been revised to show the permanent casing projecting 12 inches above the well house floor.

6. The drawings have been revised to show the casing diameter and corresponding drill hole diameter for each casing transition.

7. Detailed specifications showing the procedures to be followed for grouting the well have been added to the report and specifications.

8. A dimension was added to the plans showing the height of the overflow from the floor of the tank and the type of pipe is now shown on the pipe description.

9. As shown on the drawings, the floor elevation of the proposed storage tank is 600.5', the high water, pump off elevation is 614.5', the pump on water elevation is 612.5', and the

max hour, low water elevation is 610.26'. The normal head range of the storage tank for average daily demand is 14' deep to 12' deep.

10. As noted on sheet 4 of 8, the inlet pipe to the storage tank will be 2 inch ductile iron (DI), and the outlet pipe from the storage tank will be 3 inch ductile iron.

11. A chain link security fence has been added to the plans.

12. Holtgrewe Farms Water Company LLC will be the continuing authority for this facility. The Articles of Organization as well as the Certificate of Organization are attached to this report. Holtgrewe Farms Water Company LLC will own the water facility and the land where the well, storage tank, and well house is located. A revised Operational and Management Plan is attached to this report and explains the procedures for ongoing maintenance, operation, and modernization of the system. The water system will only serve the Holtgrewe Farms subdivision and will have service available at each lot. A legal description of the service area will be filed with the application to the Public Service Commission to ensure future lot owners that service is available. Upon completion of the final plat for the subdivision, easements along all water lines will be dedicated to the continuing authority for the purpose of installation, maintenance, and repair of the water system.

13. The operational and management plan has been revised and attached to the updated "TMF Checklist Response Letter".

Nothing Follows

Ron DeClue
Wunderlich Surveying & Engineering Inc.