

# Drinking Water Tech Tips: Small Water Systems – Pump Controls

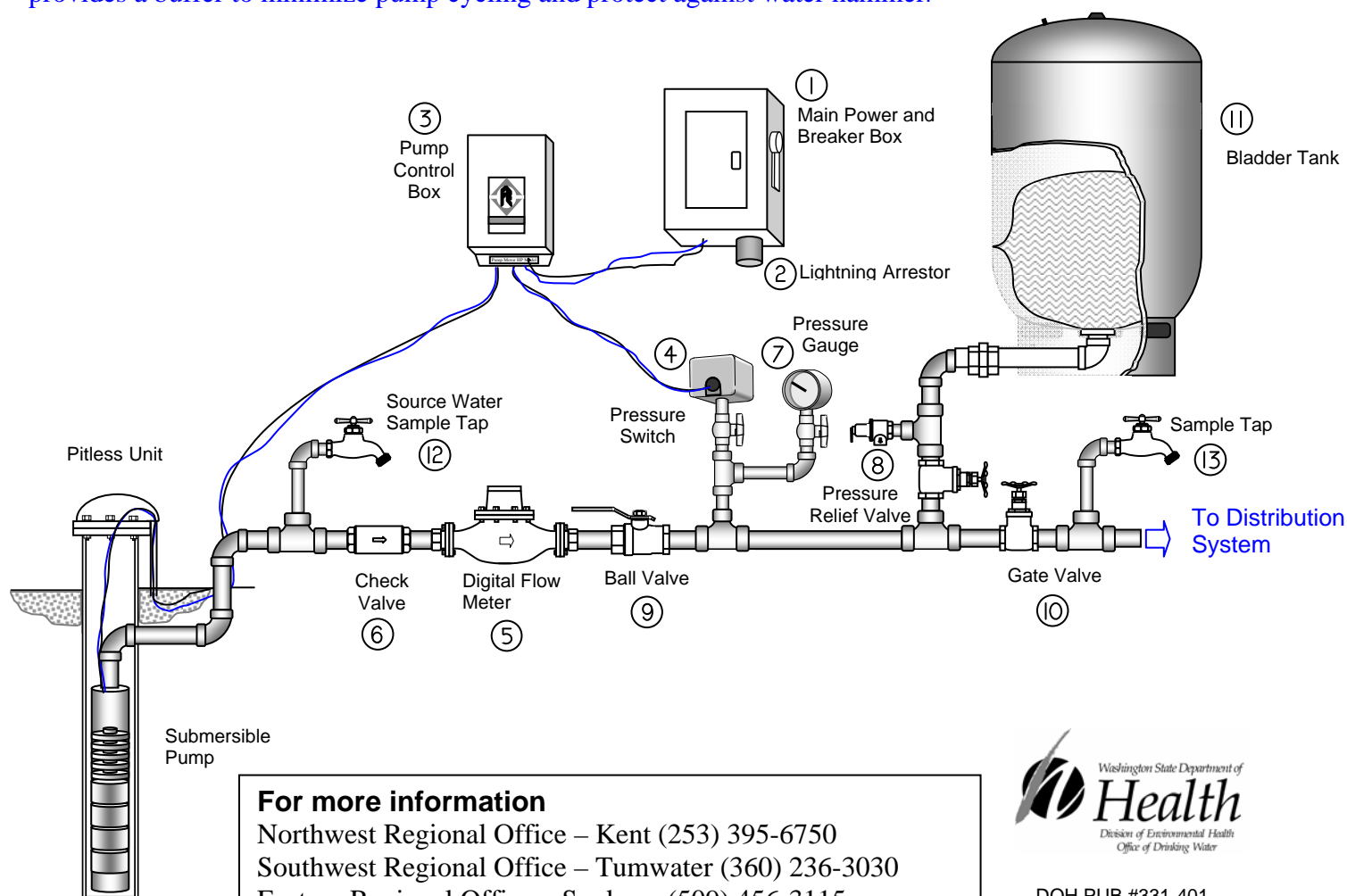
**Pump Controls** regulate source production to maintain adequate flow rates and water pressures. Water systems adjust their control systems to maintain:

- ◆ A minimum pressure of 30 psi in the water distribution system.
- ◆ A minimum pressure of 20 psi during fire flow conditions.
- ◆ Adequate water levels in storage tanks and pressure vessels.
- ◆ Adequate free chlorine levels in systems that require chlorination.
- ◆ Adequate protection of pumps and electrical equipment during emergencies, such as power outages, water outages, voltage fluctuations and equipment malfunctions.

Many small water systems have a single-source well with a submersible pump controlled by a pressure switch. The pressure switch senses pressure in the supply line. When line pressure drops, the pressure switch signals the pump control box to start the well pump.

## Control System – Pressure Switch and Bladder Tank

The bladder tank (11) contains pressurized air and water separated by a membrane called the bladder. As water pressure changes, the volume of air contracts and expands triggering the pressure switch (4) on or off. This provides a buffer to minimize pump cycling and protect against water hammer.



- (1) **Main Power and Breaker Box** – protect controls, electrical components and pumps from over-amperage. It is installed where electrical power enters the pumphouse. The manual pull-down switch turns the power on and off.
- (2) **Lightning Arrestor** – protects the pump motor and controls from voltage surges caused by lightning, switching loads and power line interference. These do not protect against a direct strike.
- (3) **Pump Control Box** – protects submersible pumps from low or high voltage, a drop in water level, low yield wells, clogged well screens, malfunctioning pumps and motors, and rapid cycling. Pump control boxes usually have microprocessors that monitor power-line voltage and pump motor power draw.
- (4) **Pressure Switch** – senses pressure in the water line and signals the pump to start and stop with pre-set low and high pressure settings. Pressure switches can control well pumps and booster pumps. Proper high and low pressure settings allow multiple pumps to operate in lead and lag mode.
- (5) **Digital Flow Meter** – measures the flow rate in gallons or cubic feet per minute. It usually indicates the total volume produced since the meter was installed. Systems use this information to monitor water production, detect distribution leaks and pumping problems, and determine peak demand.
- (6) **Check Valve** – allows water to flow only one direction. Submersible well pumps require spring loaded check valves to maintain system pressure and prevent backflow of water from the system into the well.
- (7) **Pressure Gauge** – measures static pressure in the water line.
- (8) **Pressure Relief Valve** – protects the pressure tank and water lines from catastrophic failure due to over-pressure. The valve opens when water or air pressure exceeds a pre-set level, usually 100 psi. The discharge line should be directed outdoors or to a location where water will not damage property or injure people.
- (9) **Ball Valve** – has a lever to open and shut the ball-shaped valve and is more reliable than a gate valve. It is more likely to actually open and close after years of use.
- (10) **Gate Valve** – opens by lifting a round or rectangular plate out of the water flow. Gate valves are designed to operate fully opened or closed and are not well suited to regulate flow. When fully open, the typical gate valve has no obstruction in the flow path, resulting in very low friction loss.
- (11) **Bladder Pressure Tank** – contains pressurized air and water separated by a membrane, the bladder. As water pressure changes, the bladder contracts and expands providing a buffer to minimize pump cycling and protect against water hammer.
- (12) **Source Water Sample Tap** – used to collect a water sample directly from the source.
- (13) **Sample Tap** – used to evaluate water quality and possible sources of system contamination.

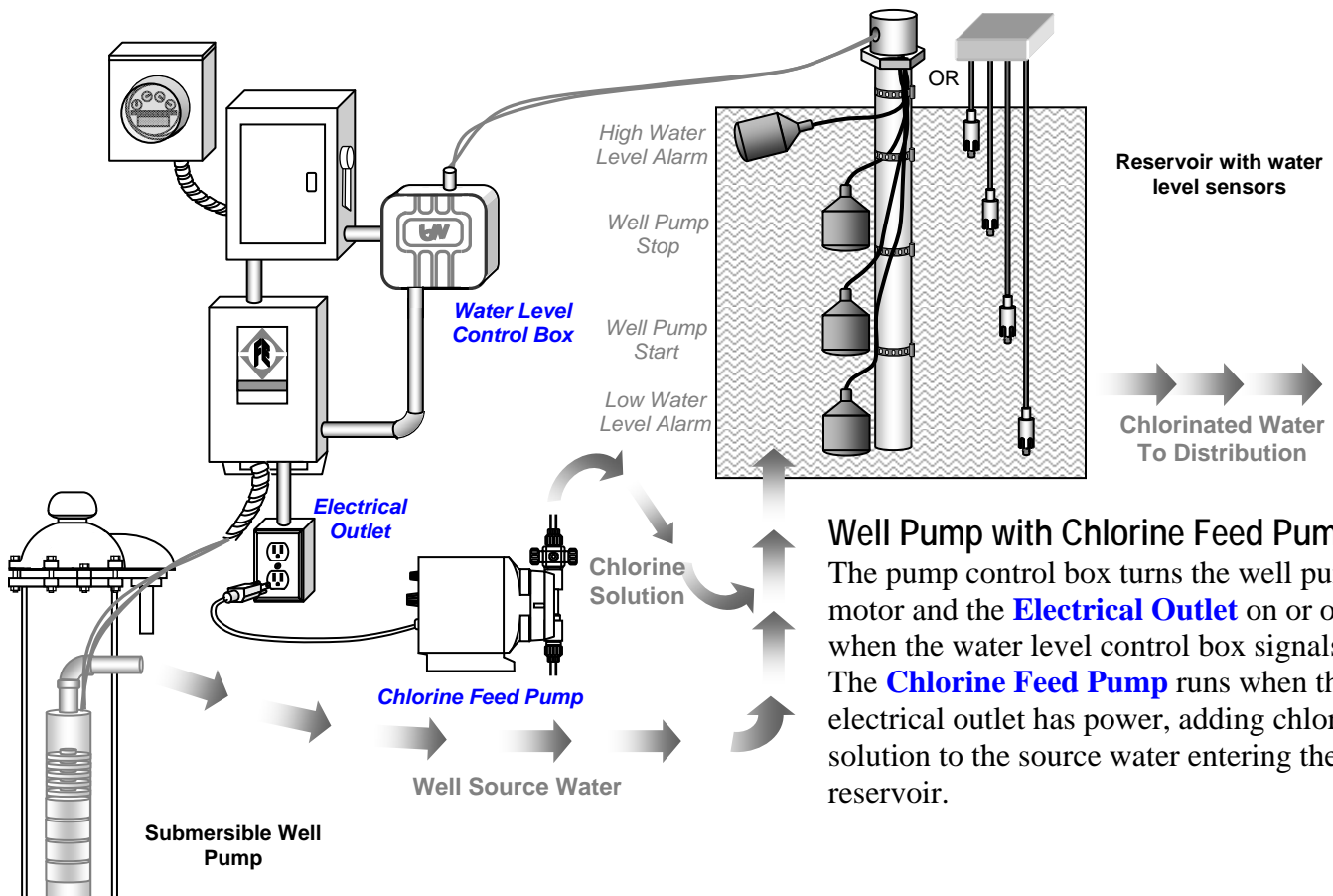
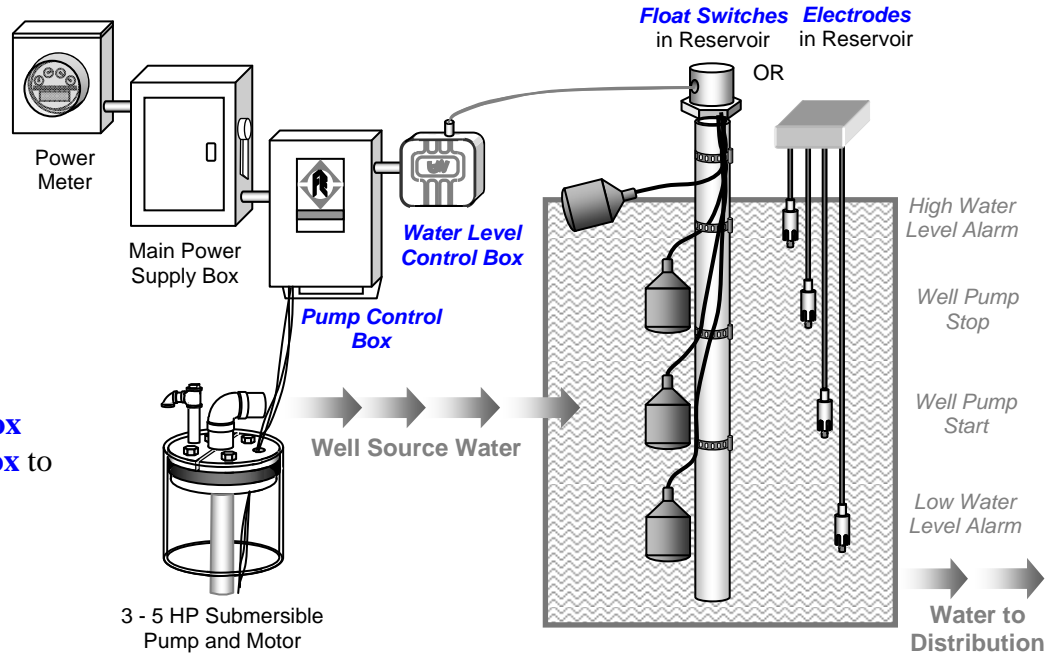
## Control System - Storage Tank Water Levels

Storage tanks provide additional capacity to meet peak demand and, in some cases, provide emergency supply when the well pump is not available. Gravity or booster pumps draw water from the storage tank into the distribution system. Pressure switches sense pressure in the supply line and signal the booster pumps to turn off or on at preset levels.

### Well Pump

As the water level in the reservoir rises or drops, sensors (**Electrodes**, **Float Switches** or **Pressure Transducers**) signal the **Water Level Control Box**.

The **Water Level Control Box** signals the **Pump Control Box** to turn the well pump on or off.



### Well Pump with Chlorine Feed Pump

The pump control box turns the well pump motor and the **Electrical Outlet** on or off when the water level control box signals it. The **Chlorine Feed Pump** runs when the electrical outlet has power, adding chlorine solution to the source water entering the reservoir.

## Common Controls

**Hands-Off-Auto (HOA) Switch** – allows the system to operate in manual or automatic mode. Some devices allow multiple wells or booster pumps to alternate, or to operate individually, in lead or lag mode, or on emergency power.

**Pump Alternator** – automatically alternates the operation of two or more pumps.

**Constant Pressure Pump Controllers** – maintain constant pressure by changing the speed of the pump motor. Special pump motors, called variable frequency drives (VFD), are needed for this arrangement.

**Submersible Pump Motor Protectors** – protect motors from high or low voltage, excessive pump cycling from waterlogged tanks, under or overload, overheated motors, or drop in water level. They may be mounted in the pump control box or HOA.

**Pump Motor Starters** – provide a temporary power boost to start high voltage motors. They may be mounted in the pump control box or HOA.

**Flow Switches** – sense water flow and send a signal to control pumps, such as chemical feed pumps. They may work with a programmable logic controller (PLC) to provide proportional addition of a chemical, such as a chlorine solution.

**Water Level Float Switches or Electrodes** – turn equipment on or off or signal alarms based on water levels.

**Emergency Power Manual Switch** – switches power from the main power supply to an emergency generator.

**Well Low-Water-Level Sensors** – turn off the well pumps when water drops below the lowest sensor. Power is not restored until the water level reaches the upper sensor.

**Solenoid Valves** – automatically open and close valves.

**Pump Run Hours** – display the total number of hours a pump has been running.