This guide is intended to provide you with a basic understanding of how lift stations work and to present suggestions for their routine maintenance and care. By following these suggestions, chances of experiencing a catastrophic lift station failure will be significantly reduced.

**How Lift Stations Work**

To begin with, there are two main elements to a lift station: the wet-well and the controls. The wet-well is a basin that the inflow is discharged into and where the pumps sit. This can be made out of steel but is more commonly made of fiberglass or concrete. Usually, there are two pumps in the wet-well, each with their own check valve and shut off valve which flow into the outflow. There can also be one or three pumps instead, although this is less common. The check valves stop the pumped flow from coming back into the wet-well when the pumps shut off and keep one pump from pumping back into the other. The shut off valve allows for the isolation of each pump. The pumps usually sit on disconnects mounted to the floor and have guide rails extending the full depth of the station which allow for the individual pumps to be removed using a cable or chain without having to enter the station.

Furthermore, stations have some sort of level sensing device. This can take the form of mechanical float switches, a transducer, or both. In the case of float switches, there are typically four used. The lowest is called the off float, the next highest is the lead float, then the lag float, and finally the high water/alarm float. The purpose for having these is that in normal operation the pumps switch back and forth after each pumping cycle. An alternator selects which pump will be the “lead.” This pump will turn on when the water level reaches the lead float. The other pump is now called the “lag,” and will turn on if the water level reaches the lag float. At this time, both pumps are now on until the off float is triggered. The next time the lead float is triggered the other pump will assume the “lead” role. This is a way for the pumps to back each other up in case a problem occurs. A transducer works by varying the amount of DC voltage it sends back to the control panel in relation to the water level in the wet-well. Triggering the pumps is handled through some kind of transducer level controller.

The control panel is the brain that runs the lift station. It contains the circuit breakers, motor starter, overloads, pump controller software (if applicable), and communication devices (if applicable). **WARNING:** The control panel may contain high voltage and phases, so take the
necessary precautions. The overload is tripped (causing the pump to turn off) if too much current is drawn by the pump. This can be caused by a dead short, locked pump, water in the motor, an object caught in the impeller, etc. The floats run off a low voltage system and use either the pump controller or a printed circuit that activates the pumps. Each pump also has a hand-off-automatic (HOA) switch. The hand position (H) runs the pump (in manual mode) and the automatic position (A) runs the pump off the level sensors. If a single phase system is used the panel would also house capacitors to start and run the pump. Typically, the control panel also displays the pump’s thermal overload protection and seal failure sensors in the form of a light and reset button. These trigger the pumps to turn off if they are tripped. The panels also contain the hour meters and phase protectors (if applicable). Remember, never assume that the power is off until you have checked it with a voltmeter and do not work on the panel until this is done.

**Pump Control Panel Safety**

Any and all operation on or in the control panel must be performed by a qualified and trained personnel and in observance of the Arc Flash and Shock Hazard PPE requirements of NFPA 70E.

**Precautions to take when working on a control panel**

Before opening the control panel enclosure:

1. These procedures should only be performed by a qualified electrician familiar with the use of power testing equipment.
2. Lock out power to the panel at the power source
3. Turn off any door mounted disconnect handles on the control panel.
4. Open the panel door and verify that the power to the panel is off by using a DVM (digital volt meter) or other power testing device. Check for power on the line side of any disconnects and fuses before performing any work within the control panel.

**Normal (non-emergency) shutdown of the equipment**
To shutdown the equipment in a non-emergency situation, place the HAND-OFF-AUTOMATIC (HOA) selector switch to the OFF position for the motor that is to be disabled.

Emergency shutdown of the equipment

To shutdown the equipment in an emergency situation, turn all disconnect handles to the off position.

Maintenance

The best way to avoid problems is to consistently keep an eye on your lift station. Get to know it and what to expect from it. Once this is done, you can spot troubles before they blow out of proportion.

The most important thing to do to care for your lift station is to read and record the hour meters every day, at the same time. A calendar or log book works great for this. Record both the total hours and daily total by subtracting the previous day’s total from the current day’s hours. If everything is working correctly, the pumps will have pumped the same number of hours each day because they alternate. Get to know how many hours to expect because this will indicate problems down the road if the numbers are off. Hour meters in all of Aqua Engineering systems turn off when the pump turns off for any reason. Because of this, if there is a difference in the hours between the pumps, the pump with the least hours is likely to be the problem pump.

The first step in diagnosing a problem is to push the manual reset for the trouble pump and see if it works because an overload may have tripped the system. Also keep in mind that it is possible the alternator is bad. To check this, turn the pumps to the hand position and if they pump down you need to look at the control circuit as the problem. A more detailed troubleshooting will be covered later.

Next, moving from the control panel into the wet-well, some inspections should be made on a varying basis to maintain its health. Inside the wet-well, inspect the walls for the grease line locations. There should be a line where the lead pump turns on and above that should be clean; if
not get a hose and wash down the sides of the wet-well. If you notice a build up above the lead line, this indicates the lag pump has to pick up the load sometimes. This can happen but is not designed to be the case. This indicates one pump is not enough to handle the inflow or there is a problem with the station. If there is a major line at the lag pump line then this indicates you have a pump that is not working.

Moving on, the floats/transducer should be inspected to see if they are free of grease. If grease builds up they may not operate correctly. To remove the grease, pull them up (after turning the HOA switch to off) and clean them with a wood paint stirrer. They should be checked daily and cleaned regularly.

Now inspect the water level itself. Is there junk floating on the surface? If so, it needs to be broken up with a hose. Do so by first breaking the mat up with the hose and running the pumps manually until they break suction. Repeat once more. This works best if done once a week or so. Once a year you should also have a pumper truck completely pump-out and clean the wet-well. Do not forget to turn the HOA switch back to automatic after doing any of this.

Every six months it is good to check and tighten up every connection point in the control panel because of the vibration caused by the contactors pulling. The can cause unexpected failures. This is also a good time to check and record the voltage and amperage of each pump. Do so leg to leg and leg to ground for each pump. For single phase systems, also check the start relay. Also inspect the wet-well for any rust and replace those parts if necessary.

When doing maintenance on one of the pumps, it is good practice to have a spare pump on hand in case the one remaining pump has problems or cannot keep up with demand. If you have a spare pump, spin the impeller every couple weeks to keep the seals from sticking. With that said, this concludes the recommended maintenance for a lift station.

**Maintenance Summary**

**Daily:** Read and record the hour meters, inspect grease line locations and hose down, inspect level sensors

**Weekly:** Clean level sensors, and break up junk on the water surface.
6 month: Tighten up connections in control panel, record volts/amps of each pump

Yearly: Completely clean the wet-well using pumper truck

Recommended Spare Parts To Keep On Hand

- Control Board (ISR relays or a solid state transducer pump controller)
- Contactor or contact point kit
- Overload block
- Floats/Transducer
- Necessary Fuses
- Run and Start Capacitors (single phase)
- Start Relay (single phase)

Start-Up/Troubleshooting

This section will cover the start-up and troubleshooting of a lift station which contains mechanical float switches. For transducer start-up and troubleshooting contact Aqua Engineering as these can be job specific.

1. Check the panel voltage at two places – either at the line voltage at the circuit breaker or disconnect switches, and at the control circuit at the terminal strip.
   a. Override bypass door switch (if supplied)
   b. Across Line One (L1) and neutral (N) you should read 120 Volts. If no voltage there, check across L1 and N at the activate door switch. If 120 Volts is not available, control circuit transformer or door switch is bad.
2. With enough water in the wet-well and the valves open, check to see that each pump runs manually by placing the HOA switch to H. Check amp draw against full load (FL) amps of pump. If pumps are 3-phase, check their rotation and reverse. This is done by interchanging any two legs at the starter (a pump running in reverse will pump, but much less than in the correct rotation and usually makes more noise).
3. If a pump does not run, check:
   a. If starter is pulling in and making contact:
      i. If it does, check overload trip and reset
      ii. If not, check the voltage at starter coil
   b. If not, check the voltage at the motor leads:
      i. If you read the correct voltage then you have motor trouble.
      ii. If you do not, trace circuit again for an open circuit

4. Now Place both pumps in the automatic mode by placing the HOA switch to the A position. You may check operation by first filling the station and then either manually tilting the mercury switches or jump the float switch terminals.
   a. Tilt the redundant switch (if equipped) or jumper its terminals, and keep tilted or jumpered.
   b. Tilt the off switch or jumper its terminals, and keep tilted or jumpered.
   c. Tilt or jumper lead pump on switch. You will note that first the ISR relay engages and then this closes the contacts activating the alternator and one starter, the pump should now be running.
   d. Drop the lead pump on switch or remove its jumper. The pump should stay on.
      Drop the off switch or remove its jumper. This should stop the pump.
   e. Repeat step “d” to check the other pump, as they should alternate automatically.
   f. With one pump running, tilt or jumper the lag pump switch. This should engage the second ISR relay and bring the lag pump on.
   g. Drop the lag pump on switch, then the lead pump on switches (or remove their jumpers. Pumps should stay on until off switch is dropped.
   h. If the panel has a redundant off switch, repeat steps “e” and “d” but do not drop the off switch or remove its jumper. Pump should turn off.
   i. Tilt the high water alarm switch or jumper its terminals. This should activate the third ISR, and turn the alarm light on.

If all these steps have been performed and operated as described your lift station is now operating correctly. Please contact Aqua Engineering for any problem or questions you encounter.