

# Automated Surface Water Treatment System

## INSTALLATION, OPERATIONS & MAINTENANCE MANUAL



# Table of Contents

1. Introduction .....	1
2. Operations Summary .....	1
3. Assembly.....	2
4. Filter Media Installation .....	6
5. System Commissioning.....	7
6. Sanitizing Procedure .....	8
7. System Start-Up.....	9
8. Operation .....	9
9. Filter Maintenance.....	10
10. Degassing the Filter Media.....	11
11. Winterization .....	11
12. Refilling .....	12
13. Decommissioning / Moving .....	12
14. Trouble Shooting .....	13

## 1 Introduction

Davnor Water Treatment Technologies Ltd. has developed a treatment system featuring an intermittently operated slow sand filtration process. It is based on the continuous slow sand filtration process that has been used for over 100 years. The BioSand Water Filter has proven effective in removing iron (and iron bacteria), manganese, sulphur odours and other obnoxious smells, turbidity, colour, bacteria, viruses and water borne parasites from drinking water supplies. Do not attempt to treat wastewater, heavily polluted or contaminated water. Please contact a Davor representative if there is any uncertainty regarding the treatability of the water.

## 2 Operations Summary

The Davor Water Treatment Technologies Ltd. surface water system is a slow sand filtration process. The operation of the system is automated for the removal of giardia cysts, cryptosporidia oocysts, other water borne parasites, bacteria, viruses, turbidity and colour. The water is pumped or gravity fed to the filter. The water flows by gravity through the filter and then the filtered water flows to a storage tank and is re-pressurized for use or further treatment.

### 3 Assembly

**Important Note:** Read the full set of instructions before beginning assembly.

You will be required to provide the following:

- Connection to the untreated water source
- 120 V electrical outlet for the pump and the solenoid valve
- Connection to the distribution line
- Connection to a drain or sump for drainage and overflow lines (optional drainage packages are available)

#### Locate System Components

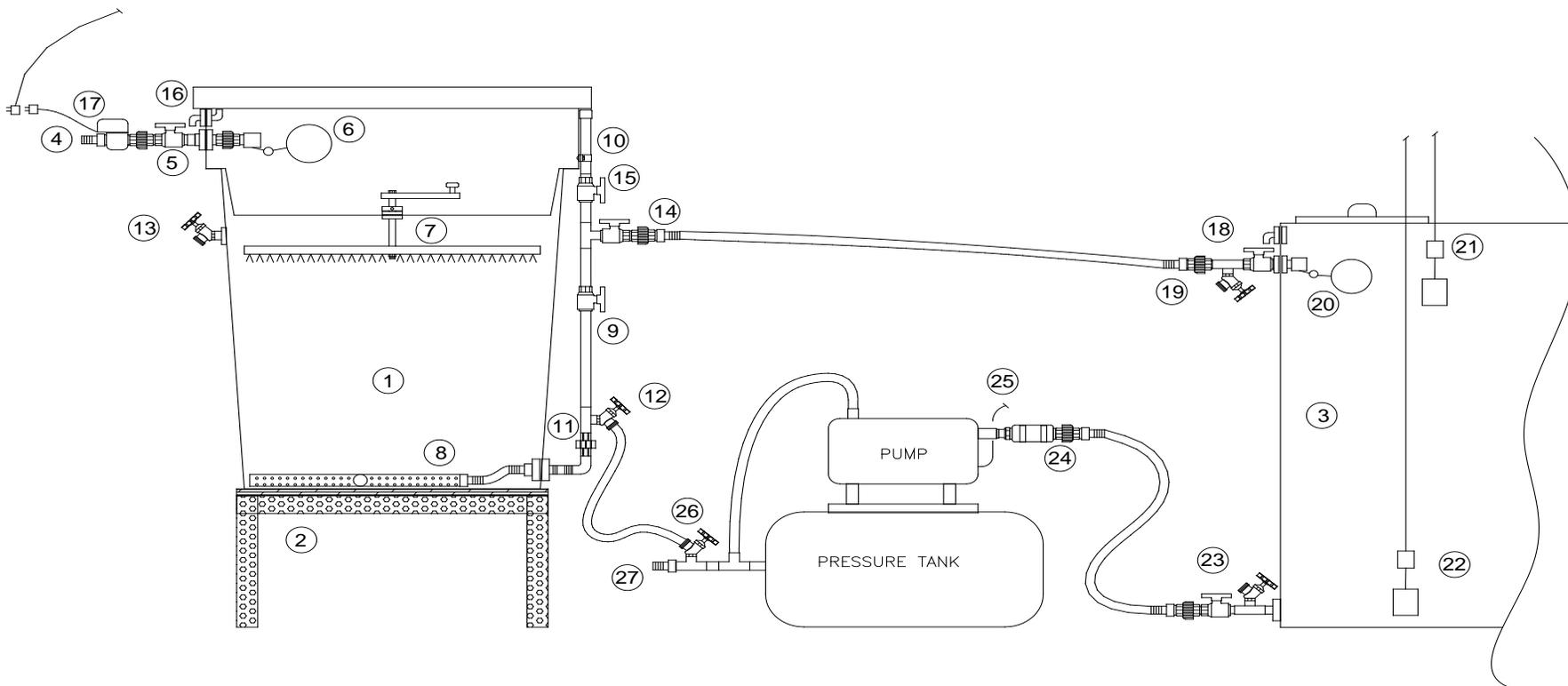
- Ensure you have all the required parts and materials for assembling the system (figure 3-1).
- Arrange the components for ease of installation and maintenance. Consider the location of the untreated water inlet, floor drain or drainage pipe and electrical outlet.
- Place the filter on the stand, place the storage tank, pump and pressure tank.

**Note:** A qualified plumber should make the connection from the untreated water inlet to the filter system and the filtered water outlet to the distribution line. Your pump and your solenoid valve may need to have electrical plugs attached to them. This work should be performed by a qualified electrician.

- Install a system bypass in case there is ever a need to take the system off line.

**Table 1- Flow Rates and Dimensions**

Model No.	Flow Rate (nominal)		Filter Dimensions			Storage Tank	
	L/m	gpm	Diameter (cm)		Height (cm)	Capacity (gallons)	Dimensions (cm) LWH
			Top	Bottom			
SA 60	1	0.25	49	29	94	200	150 x 70 x 90
SA 120	2	0.5	64	42	94	200	150 x 70 x 90
SA 240	4	1.0	78	58	94	200	150 x 70 x 90



**Figure 3-1 Automated System Layout**

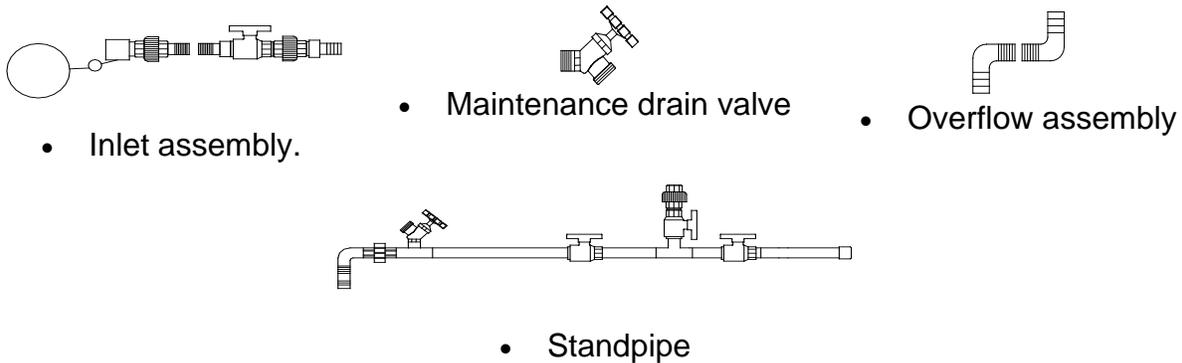
- |   |  |  |
|---|--|--|
| 1. BioSand Filter                           | 12. Standpipe Lower Valve                          | 21. High Level Float Switch (to the solenoid valve)                          |
| 2. Filter Stand                             | 13. Maintenance Drain Valve                        | 22. Low Level Float Switch (to the pump)                                     |
| 3. Storage Tank                             | 14. Filter Outlet Valve                            | 23. Storage Tank Outlet with Union Connection, Shutoff Valve and Drain Valve |
| 4. Raw Water Inlet                          | 15. Anti-siphon Valve                              | 24. Check Valve  |
| 5. Filter Inlet Valve                       | 16. Filter Overflow                                | 25. Pump Electrical Outlet (to the low level float switch)                   |
| 6. Filter Float Valve with Union Connection | 17. Solenoid Valve (to high level float switch)    | 26. Clean In Place (CIP) Reverse Flow (attached to standpipe lower valve)    |
| 7. Clean In Place (CIP) and Diffuser Basin  | 18. Storage Tank Inlet Valve with Union Connection | 27. To Distribution or Further Treatment (softener, Reverse Osmosis, UV)     |
| 8. Underdrain                               | 19. Sampling Valve                                 |  |
| 9. Flow Rate Control Valve                  | 20. Storage Tank Float Valve                       |  |
| 10. Filter Standpipe                        |  |  |
| 11. Standpipe Union Connection              |  |  |

### **Important Notes:**

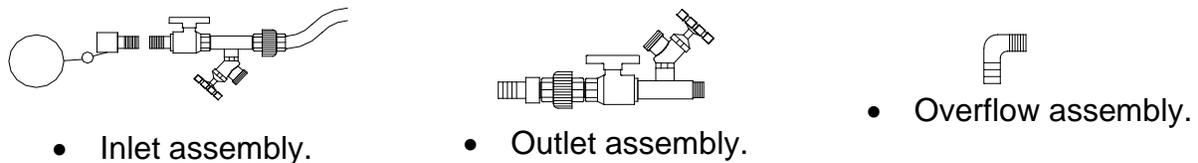
- All of the assembled components have been loosely fitted together. Use Teflon tape on all threaded connections and tighten. **Do Not Over-Tighten** the PVC fittings. (They will crack if over-tightened)
- Refer to Figure 1 to find the locations for all system components.
- Heat the end of hose connections in hot water before installing. Use the gear clamps to fasten the hose to the barb fitting.

## Install Assembled System Components

**Step 1.** Locate and attach the BioSand water filter assemblies.



**Step 2.** Locate and attach the filtered water storage tank assemblies.



**Step 3.** Place the pump and pressure tank.

**Step 4.** Install the low level and high level float switches in the storage tank shown in Figure 3 -1. To do this, start by removing the supporting ring on the manway of the filtered water storage tank. Position the low level switch near the bottom of the filtered water storage tank and the high level switch near the top. Use the notched grooves to locate the cords for the switches. Replace the supporting manway ring to hold the level switches in place.

## Piping Connections

**Step 5.** Using the 3/4" braided hose for connection between the barbed fittings;

- Connect the raw water supply to the solenoid valve inlet. Look for the flow direction on the solenoid body.
- Connect the solenoid outlet to the filter inlet.

**Note:** The solenoid can either be attached directly to the filter inlet or mounted to the filter stand or another convenient location.

- Connect the filter outlet at the filter outlet valve to the filtered water storage tank inlet.

**Step 6.** Using the 1" braided hose for connection between the barbed fittings;

- Connect the filtered water storage tank outlet to the pump inlet.
- Connect the pump outlet to the pressure tank.

**Step 7.** Connect the overflows to the floor drain or sump. Use a separate drain line for the filtered water storage overflow. This will prevent a cross connection between the filter and the filtered water storage tank. Leave an air space between the overflow drain line and the drain to prevent the drain from backing up into your filter.

**Step 8.** Install the filter CIP reverse flow assembly downstream of the pump (figure 3-3).

**Step 9.** Connect the hose from the CIP reverse flow valve downstream of the pump to the lower valve on the filter standpipe.

**Step 10.** Connect the filtered water outlet downstream of the CIP reverse flow to the distribution system.

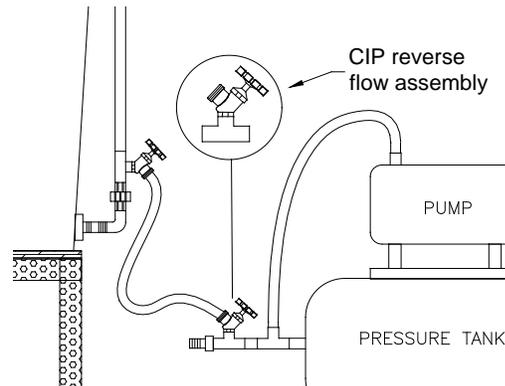
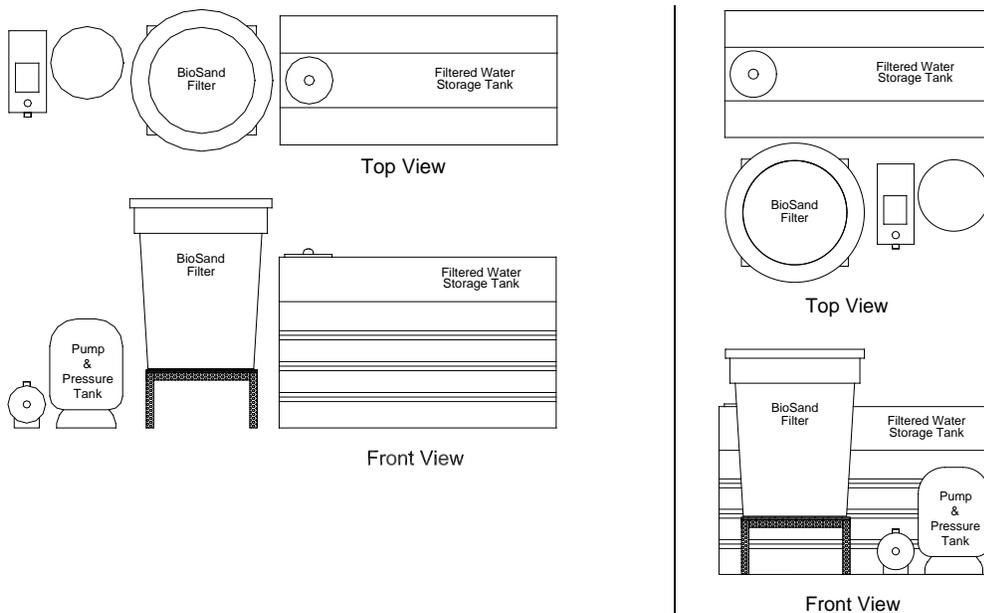


Figure 3-3

Figure 3-4 Typical System Layouts



## 4 Filter Media Installation

**Step 1.** Leak test the filter. Close all valves except the flow rate control valve and fill the filter with water to the maximum water level. Drain the filter and repair any leaks before installing the filter media.

**Step 2.** Ensure all the filter valves are closed. Fill the filter 1/3 full with water. You can use the water you will be filtering for this purpose.

**Note:** Always add the sand to water in order to prevent air locking in the sand bed of the filter. The sand should be poured quickly to prevent lensing, which will reduce the filter's flow rate. You will need to add more water as the sand is being added. When adding additional water, pour it through the diffuser to prevent mixing of previously installed sand layers. Approximately 15 cm of water above the sand is desirable.

**Step 3.** Add the underdrain gravel to the level indicated (figure 4-1).

**Step 4.** Level the surface of the underdrain gravel. Referring to Figure 4-1, add the #3 sand to the level indicated on the filter body. Repeat this procedure with the #2 sand and the #1 sand.

**Note:** There may be more sand than required. Do not over fill the sand levels. However, since the #2 sand tends to settle, it is acceptable to overfill the #2 sand by a centimetre above the indicated level.

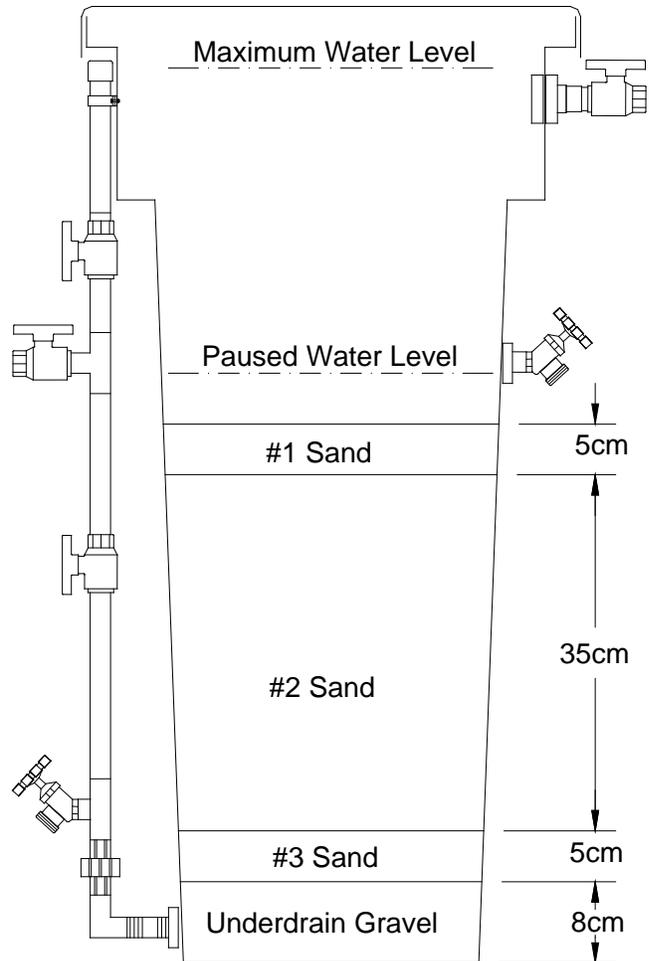


Figure 4-1 Filter Media and Filter Water Levels

**Step 5.** After all of the media has been installed, use the maintenance drain on the side of the filter to drain the dirty water off the surface.

## 5 System Commissioning

**Step 1.** Begin by ensuring all valves are in the closed position.

**Step 2.** Place the diffuser basin into the filter. Adjust the height of the CIP cleaning arm, using the set screw collar, so that it rests on the surface of the filter media. Attach the filter float valve (figure 5-1).

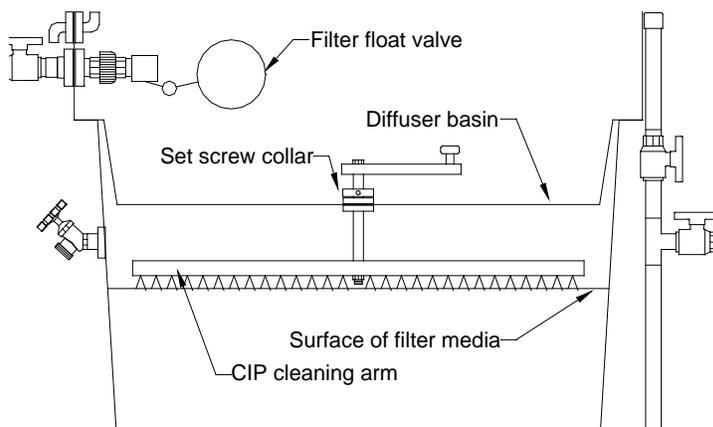


Figure 5-1

**Step 3.** Plug the solenoid valve electrical outlet into the storage tank upper float switch in a piggyback fashion and plug into the wall outlet. Test the solenoid by moving the upper float switch. The solenoid valve should open when the float switch is moved to the down position.

**Step 4.** Open the filter inlet valve to begin filling. Adjust the mechanical float valve in the filter such that the water level does not go higher than the filter overflow. Now wait until the water level reaches the maximum water level in the filter (Figure 4-1).

**Note:** See Table 2 to obtain the filter flow rate. It is critical that the filter be operated at this flow. Faster flows will compact the upper sand layer, increase filter maintenance requirements, and may cause poor filter performance. To ensure that this flow rate is maintained the flow rate control valve should be set for the nominal flow rate as described in the following steps and not moved from that position unless there is a significant change in the inlet water temperature.

**Table 2- Flow Rates**

Model No.	Flow Rate (nominal)	
	L/m	gpm
SA 60	1	0.25
SA 120	2	0.5
SA 240	4	1.0

**Step 5.** Open the anti-siphoning valve. Close the storage tank inlet valve. Open the sampling valve at the storage tank inlet (Figure 5-2). Be prepared to collect water from this point during the next step.

**Step 6.** Set the flow rate by adjusting the flow rate adjustment valve on the standpipe. until the flow through the sampling valve matches the value in Table 2. The flow can be measured by timing how long it takes to fill a 2-litre pop bottle.

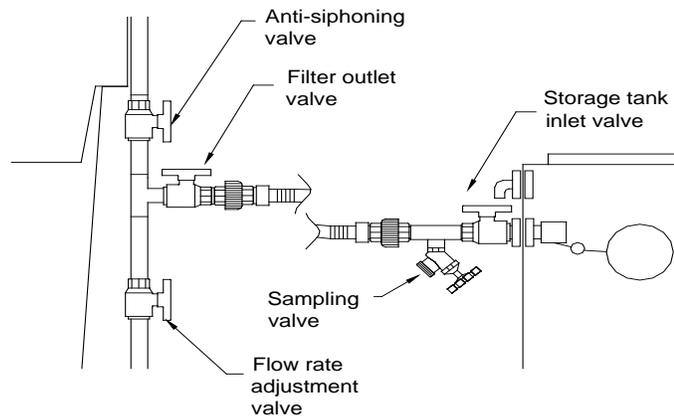


Figure 5-2

**Step 7.** Connect a hose to the sampling valve at storage tank inlet and begin flushing water through the filter. Flush the filter until the water becomes clear. Close the sampling valve.

## 6 Sanitizing Procedure

Care is taken during the manufacture of your water filter to keep it clean and sanitary. However, during shipping, storage, installation and operation, bacteria could get into the water filter piping. For this reason, sanitizing is recommended after installation. On some water supplies, additional periodic sanitizing is also recommended.

**Step 1.** Prepare a dilute bleach solution for sanitizing by mixing 5 ml of common household bleach (Javex, Clorox, etc.) with 1 litre of water.

**Step 2.** Close the filter inlet valve and allow the filter water level to drop to the “paused” level. Close the storage tank inlet valve. Attach the refill hose to the lower valve on the filter standpipe. Insert a funnel into the end of the hose. Ensure the flow rate adjustment valve and the anti-siphoning valve are open. Open the lower valve on the filter standpipe (figure 6-1).

**Step 3.** Hold the end of the hose at the same height as the top of the filter. Pour the solution into the funnel. Close the lower valve on the filter standpipe. Let the solution “sit” for 20 minutes. This will give sufficient contact time for the sanitizing solution to kill any bacteria that may be present.

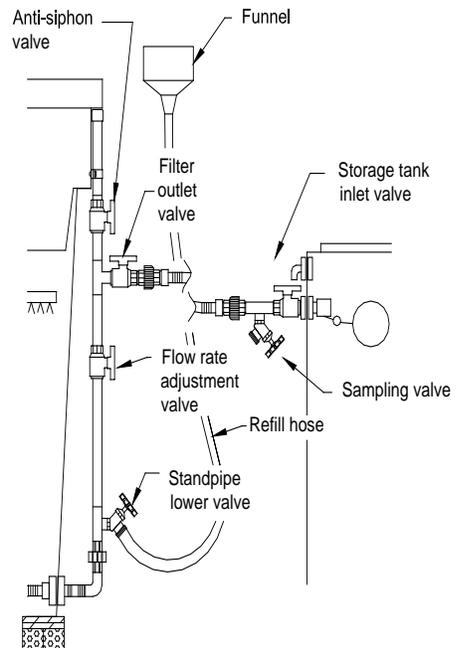


Figure 6-1

**Step 4.** Open the filter inlet valve. Flush the sanitizing solution through the sampling valve.

**Note:** The filter will not achieve 100% removal of bacteria. If you do not have downstream chlorine injection bacteria may colonize in the piping downstream of the filter and the storage tank. Periodic sanitizing of the piping and storage tank will address this problem.

## 7 System Start-Up

**Step 1.** Open the inlet valve to the filtered water storage tank and continue filtering water.

**Step 2.** Adjust the low-level float switch in the filtered water storage tank. The low level float switch should be set such that the water level does not go below the storage tank outlet. The mechanical float should be set such that the water level does not go above the storage tank overflow. Adjust the high-level float switch in the filtered water storage tank. The high-level float switch should be set at a level just below the mechanical float valve.

**Step 3.** Prime the distribution pump, following the pump manufacturer's instructions.

**Step 4.** Plug the pump electrical outlet into the storage tank low level switch in a piggyback fashion, and plug into the wall outlet. Test the pump by moving the lower float switch. The pump should operate when the switch is moved to the 'up' position.

**Step 5.** Water should continue to run through the system until the water level in the filtered water storage tank is just below the overflow. The high-level float switch should close the solenoid valve and allow the filter to drain to the "paused" water level. The mechanical float valve will stop the flow of water if the high-level float switch is out of adjustment. Adjust the mechanical float valve and high-level float switch as required. Check the system for plumbing leaks and repair as required.

## 8 Operation

**Note:** In cases where extremely turbid water is being treated, it may be necessary to perform filter maintenance immediately following installation.

**Step 1.** The system is operational once the filter flow rate has been set, water has been flushed through the filter and the standpipe has been sanitized.

**Step 2.** Ensure the anti-siphoning valve is fully open during normal operation.

**Step 3.** To test the system, turn on a water source, such as a bath tap. The pump should start up and draw water from the storage tank.

**Step 4.** Continue the water demand until you are sure the system is functioning well and all mechanical floats and storage tank level switches are adjusted as specified.

**Step 5.** Your BioSand Filter system is now up & running. During normal operation, the flow rate will decrease as the filter accumulates sediment on the top layer of sand. Once an acceptable flow rate cannot be maintained, it will be necessary to perform maintenance on the filter.

## 9 Filter Maintenance

**Step 1.** Close the inlet valve to the filter. Allow the filter to drain to its "paused" level before beginning this procedure.

**Step 2.** Close the filter outlet valve (figure 9-1).

**Step 3.** Remove the filter float valve assembly at the union connection.

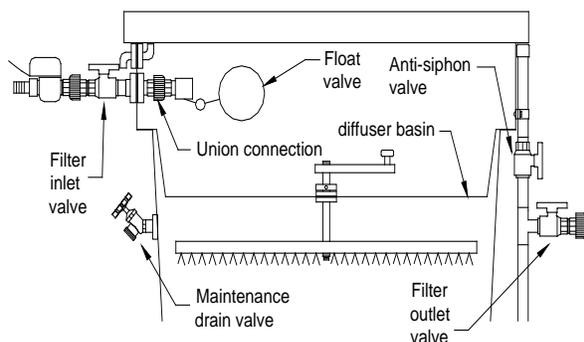


Figure 9-1

**Step 4.** Connect the CIP hose to the CIP reverse flow valve downstream of the pump. Open the valve to ensure that the flow rate restriction device is limiting the flow rate to approximately 4 litres per minute to prevent damage to the filter media. Connect the other end of the hose to the lower valve on the filter standpipe (figure 9-2). Open both valves and dispel any air in the line through the anti-siphoning valve. Close the anti-siphoning valve.

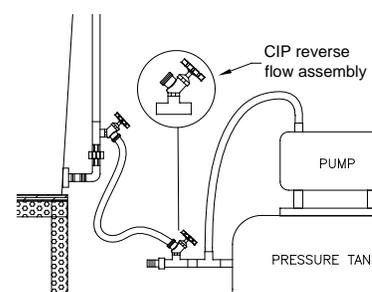


Figure 9-2

**Step 5.** Turn the handle on the clean in place (CIP) mechanism to agitate the top of the sand while the water level is slowly filling from the bottom. Allow the water level to rise until the diffuser basin is filled with water.

**Step 6.** Once the diffuser basin is full of water, stop stirring the CIP and wait for 30 seconds. Now flush the dirty water from the sand surface through the maintenance drain.

**Note:** It is important to wait for 30 seconds after stirring the sand before flushing the dirty water off the top of the filter media. This will prevent sand from being lost from the top layer of the filter media.

**Step 7.** To restart the filter, close the filter maintenance drain valve, the CIP reverse flow valve downstream of the pump and the lower valve on the filter standpipe.

**Step 8.** Re-attach the filter float valve assembly inside the filter. Open the inlet valve to the filter and the anti-siphoning valve on the filter.

**Step 9.** Open the filter outlet valve.

**SUGGESTION:** Keep a maintenance log posted nearby to keep track of when the filter is maintained.

## 10 Degassing the Filter Media

Degassing is part of the normal filter maintenance procedure. In some situations, the surface of the filter media may appear clean, but there is low flow. This is an indication the filter media is air locked. This may be due to accidental de-watering of the filter or the presence of dissolved gases (hydrogen sulphide, carbon dioxide, air, methane) in the raw water source. Air locking in the filter bed will cause a reduction in the flow rate through the filter. Remove the trapped gases from the filter media using the following procedure.

**Step 1.** Close the filter inlet valve and outlet valve.

**Step 2.** Remove the filter float assembly at the union connection and remove the diffuser basin to view the top surface of the sand.

**Step 3.** Connect the CIP hose to the CIP reverse flow valve downstream of the pump. Open the valve to ensure that the flow rate restriction device is limiting the flow rate to approximately 4 litres per minute to prevent damage to the filter media. Connect the other end of the hose to the lower valve on the filter standpipe (figure 9-2). Open both valves on the CIP hose and dispel any air in the line through the anti-siphoning valve. Close the anti-siphoning valve.

**Step 4.** The water will slowly enter the filter from the bottom, expelling any trapped gasses through the filter surface. Continue to bottom fill the filter until you don't see any more air bubbles surfacing. Be sure to run this for a minimum of 15 minutes to ensure all gas pockets are filled with water. Periodically tap the sides of the filter during this process. Drain excess water through the maintenance drain.

**Step 5.** To restart the filter, close the filter maintenance drain valve, the CIP reverse flow valve downstream of the pump and the lower valve on the filter standpipe.

**Step 6.** Replace the diffuser basin. Re-attach the filter float assembly. Open the anti-siphoning valve and the outlet valve.

## 11 Winterization

Do not allow the filter system to freeze when it is filled with water. Winterization consists of the following steps.

**Step 1.** Perform a complete maintenance cycle on the BioSand Water Filter as described in Section 9.

**Step 2.** Unplug the pump.

**Step 3.** Turn off the water supply and drain the filtered water storage tank and the plumbing system. Make sure all water is drained from the pump head. (See the pump manufacturer's instructions.)

**Step 4.** Close the outlet valve and anti-siphoning valve.

**Step 5.** Undo the hose from the lower valve on the filter standpipe. Slowly drain all of the water out of the sand bed using the standpipe lower valve.

## 12 Refilling the BioSand Water Filter

**Step 1.** Attach the refill hose to the lower valve on the filter standpipe. Insert a funnel into the end of the hose and hold it above the filter. Pour water into the funnel, allowing water to fill the filter from the bottom (figure 12-1).

**Step 2.** The water will slowly enter the filter from the bottom, expelling any trapped gasses through the filter surface. Continue to bottom fill the filter until you don't see any more air bubbles surfacing. Periodically tap the sides of the filter during this process. Drain excess water off the media surface through the maintenance drain.

**Step 3.** To restart the filter, close the maintenance drain valve and follow the procedure outlined in Section 5 of this manual to start up the entire treatment system.

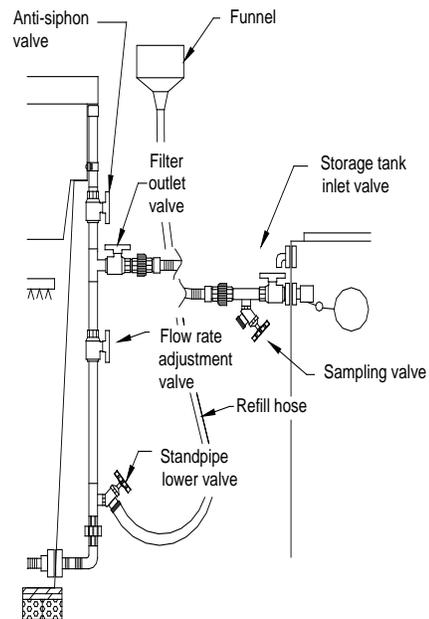


Figure 12-1

## 13 Decommissioning / Moving

The system can be decommissioned and moved to a new location. Care must be taken to label all parts and components for ease of re-installation.

**Note:** Do not move the filter with media in it.

**Step 1.** Perform a complete maintenance cycle on the filter.

**Step 2.** Close and disconnect the raw water inlet and the filtered water outlet.

**Step 3.** Drain the entire system.

**Step 4.** Disconnect the filter from the storage tank.

**Step 5.** Remove, clean and label all parts and components from the filter and storage tank.

**Step 6.** Remove the filter media. Take care to remove the layers of the media without mixing. Store the media in **clean** woven poly bags or plastic pails. Label the media as it is removed, especially the #1 sand and #2 sand, for ease of re-installation.

**Note:** The filter media is wet and will be heavy. If desired, new media can be ordered from Davnor.

**Step 7.** Follow the system installation instructions to re-install.

## 14 Trouble Shooting

Problem	Possible Cause and Solution
Low flow rate	<ol style="list-style-type: none"> <li>1. Filter flow rate has slowed due to sediment build up on the top layer of sand. Perform maintenance on the filter (Section 7).</li> <li>2. Filter has become air-locked due to dissolved gases in the water coming out of solution. Follow the degassing procedure (Section 9).</li> <li>3. Draining the filter below the top of the sand. Follow the degassing procedure (Section 9).</li> <li>4. Outlet valve has been closed. Ensure that it is open.</li> <li>5. Surface of sand has become compacted due to excessive flow rate. Follow the degassing procedure (Section 9).</li> <li>6. Inlet water temperature has dropped since the flow rate control valve was last set. Reset the control valve (Section 5). Note that the valve will have to be reset again when the water temperature increases.</li> </ol>
Water not entering the filter	<ol style="list-style-type: none"> <li>1. Filter inlet valve not fully open. Check the valve to the filter.</li> <li>2. Mechanical float valve out of adjustment. Re-adjust as required.</li> <li>3. Solenoid valve closed. See solenoid valve not functioning below.</li> </ol>
Storage tank overfilling	<ol style="list-style-type: none"> <li>1. Mechanical float valve out of adjustment. Re-adjust as required.</li> </ol>
Pump not operating	<ol style="list-style-type: none"> <li>1. Storage tank low level float switch out of adjustment. Re-adjust as required.</li> <li>2. Pump doesn't have electricity. Check electrical connection and breakers.</li> <li>3. Valves not open. Check valves on the storage tank and pump / pressure tank.</li> <li>4. Consult the pump manufacturer's instructions.</li> </ol>
Solenoid valve not functioning	<ol style="list-style-type: none"> <li>1. Check float switch adjustment. Re-adjust as required.</li> <li>2. Check electrical outlet. (Solenoid is normally closed)</li> <li>3. Consult the solenoid manufacturer's instructions.</li> </ol>