

OWNERS MANUAL

Rainwater Harvesting and Water SUPPLY System

for The Ruby Alton House
Demonstration Project
661 Isabella Pt. Road, Salt Spring Island, BC



Prepared for the Islands Trust Fund
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This manual has been prepared to help the owner of the Ruby Alton House (the Islands Trust Fund) understand the rainwater catchment, storage and water supply system. It should be considered a part of the house and remain with it if the house is resold.

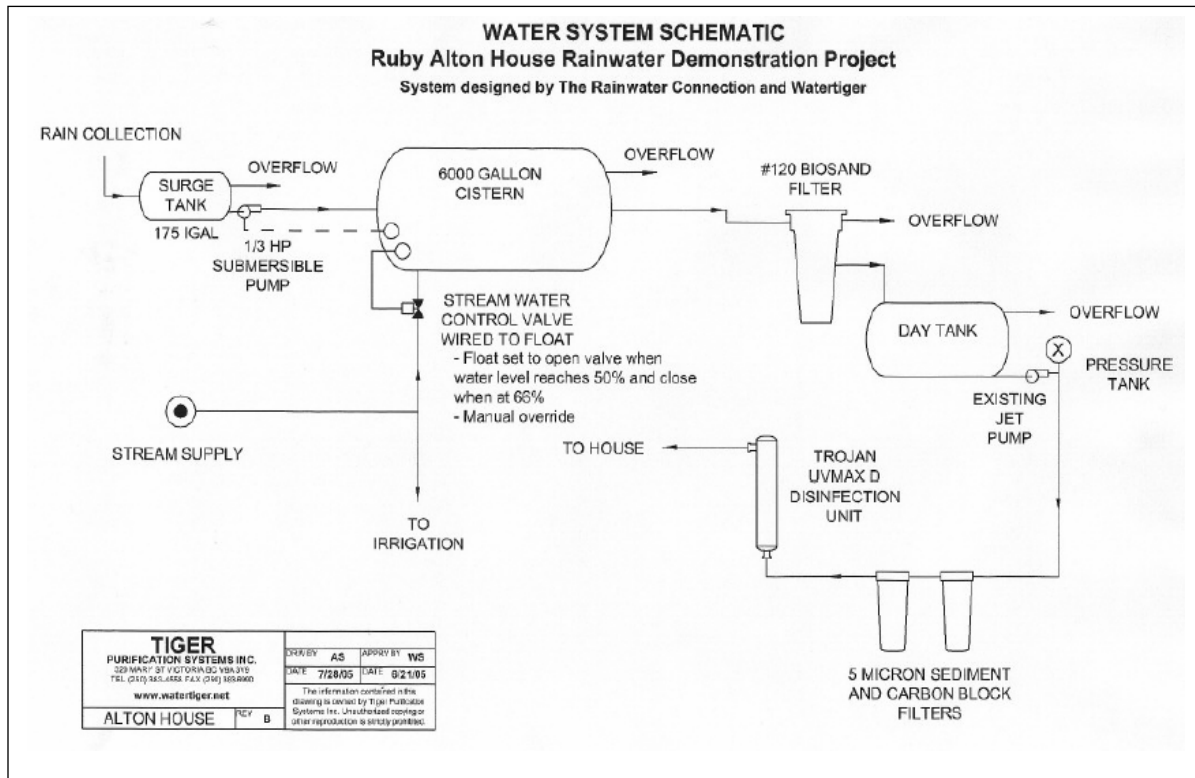
The system was completed and operational in June 2005. It will supply a dependable and safe source of household water if operated and maintained in accord with these instructions, and the safety guidelines listed in Section 4.

The manual has been prepared by The Gulf Islands Rainwater Connection Ltd., the company that designed and installed the rain harvesting system. It is not warranted that all possible situations are addressed in this manual. The owner/operator of the system is responsible to contact the Rainwater Connection immediately if questions arise.

1.0 SUMMARY DESCRIPTION

The Ruby Alton system provides a good quality source of rainwater to mix with an existing stream water supply source, and a water purification system to provide potable water for a four person rural residential home that previously relied entirely on the water from a nearby stream.

The *Water System Schematic* below shows the interrelationship of the system components.



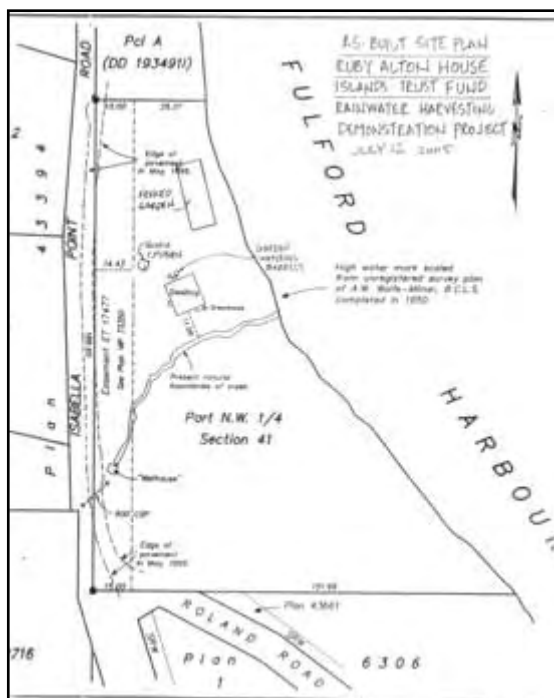
Key features of the Alton House system include:

- Potable water system using rooftop catchment of rainwater to supplement the present stream water supply;
- Estimated 141,000 litres (31,000 Imperial gallons) of rainwater catchment annually from a 180 m² (1,940 sq. ft.) catchment area;
- In a year with average precipitation levels, rainfall combined with storage of approximately 27,200 litres (5,980 Imperial gallons) will provide over 60% of the annual water needs for a water conserving, 4 person household assumed to use 151 litres or 33.3 Imperial gallons per person per day. (See May 25, 2005 report *Water Balance Table and Water Requirements in Appendix A*);
- Three stage cleaning of the water before it enters the cistern (leaf and large debris removal, sediment removal in catchment pipes, and mesh screen filtration);
- Gravity rainwater flow to surge/ pump tank and transfer pump to cistern;
- Manual or automatic supply of stream water to the same cistern;

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- Polypropylene lined steel cistern measuring 14 feet 7 inches in diameter and 6 feet high with a nominal capacity of 28,370 litres (6,240 Imperial gallons);
- Gravity flow from cistern to BioSand filtration system and house day tank; and
- Additional particle filtration (to one micron) and rural standard UV light for final disinfection.

2.0 DESCRIPTION OF SYSTEM COMPONENTS



This section of the Manual describes each of the components of the Rainwater collection and storage system; the features that allow the addition of stream water to the cistern, and the water disinfection system.

It provides a written and pictorial record of the system as it was constructed in June, 2005, and it explains the intended function of each component.

Further information on operation and maintenance is provided in Section 3 of this manual.

The house and property (including the creek and the “wellhouse” or stream catchment basin) are shown on the attached *As Built Site Plan* dated July 12, 2005. The components of the rainwater catchment and water supply system installed in June 2005 are described below.

2.1 Roof, Gutters and Downspouts

The system collects from the entire house roof with a total catchment area of 180 m² (1,937 sq. ft.) measured as the horizontal plane under the roof, including the overhang. The east roof catchment area accounts for 60% of this total (107.4 m² or 1,156 sq. ft.). The west roof catchment area is 72.5 m² or 781 sq. ft.

Extensive hand cleaning of moss and roof debris from the asphalt shingle roof was required. Zinc strips were added to reduce future moss growth. The initial water test (taken at the surge/pump tank) showed Zinc concentrations of 0.006 (well below the Aesthetic Objective of the Canadian Drinking Water Guidelines of 5.0 mg/L).

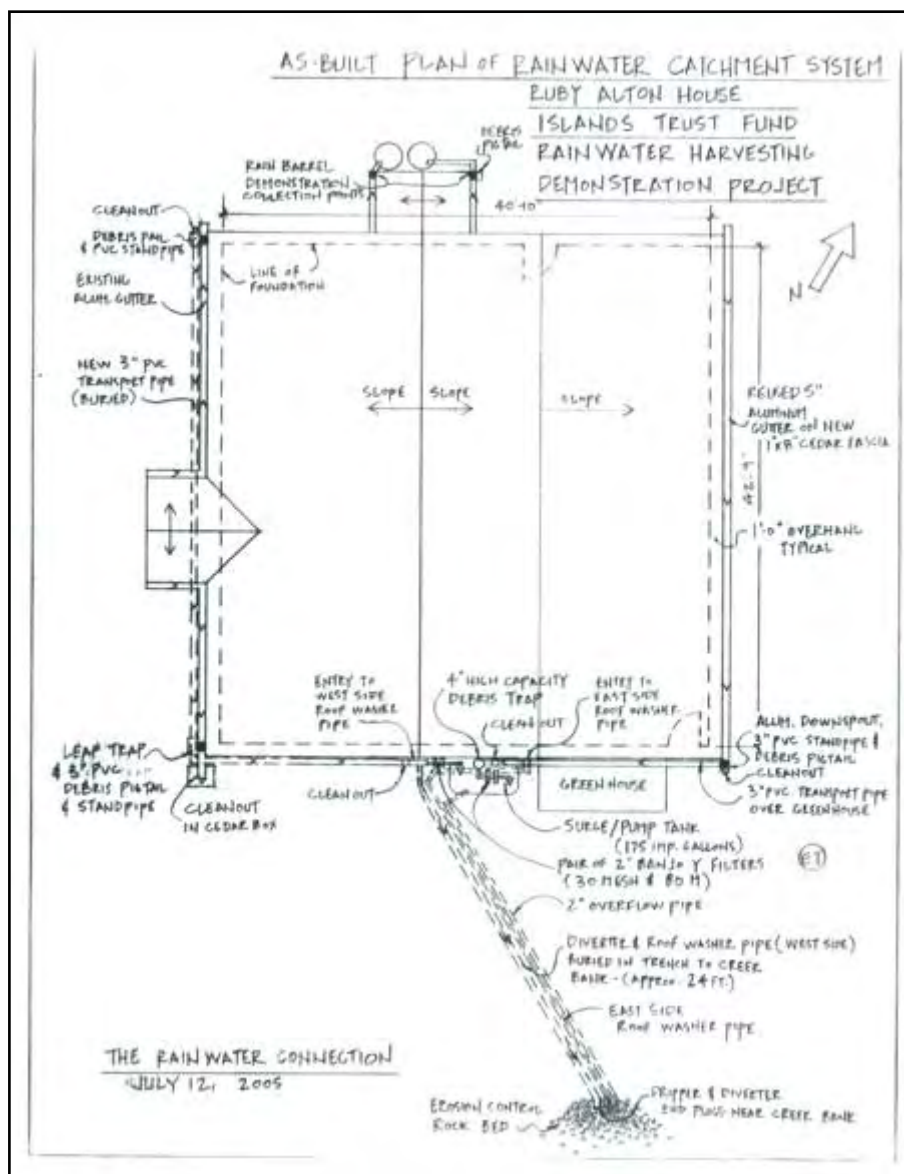


A new fascia was installed on the east side of the house. The existing 5 inch continuous aluminum gutter was judged to be in good enough condition, and was rehung with a 3-4 inch drop in its 45 foot length. The existing 2” by 3” downspouts were also reused. The existing gutters and downspouts on the remainder of the house were retained and thoroughly cleaned.

Gutter Guard was not installed at this time, and it is anticipated that the gutter slope will be sufficient to allow the gutters to self clean. The gutter condition will be monitored over the next year to determine if use of gutter guard will be required.

2.2 Debris Traps, Rain Catchment Piping and Filters

As shown on the *As-Built Plan of Rainwater Catchment System* dated July 12, 2005, the roof water is collected into three downspouts and enters mechanical debris traps before running into a sealed catchment pipe system. Using the site topography, all of the water flows by gravity through this catchment piping and through screen mesh filters before entering the surge/pump tank located along the south wall of the house.



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The following photos describe the details.



All of the water from the east gutter is delivered into 3 inch sealed piping equipped with a long debris pigtail to entrap heavier black organics and other debris. The 3" piping and fittings are CSA approved PVC sewer pipe. When the pigtail fills, the water flows through horizontal pipe over the green house. To prevent frost damage it will be important to ensure this pigtail plug is dripped empty between rains.

Sealed piping from east gutter with long debris pigtail.

A cleanout plug in this horizontal pipe provides a means of seasonally cleaning the pipe. The rainwater then drops down into a high capacity 4" debris filter for catchment of needles and leaves (a Rainwater Connection product). This filter has been tested and shown to be able to accommodate the 100 year storm volumes which could come off this roof area. This filter requires only periodic emptying and cleaning. The final water cleaning is done by two 2" Y Strainers with 30 and 80 stainless steel mesh screens operating in series. The water is then carried through 2" schedule 40 pipe into the surge/pump tank.

Cleanout on horizontal pipe, high capacity 4" debris filter, and two 2" Y Strainers.



Leaf trap combined with 3" debris trap and pipe cleanout plug

An 8 inch welded steel Debris Pail (a Rainwater Connection product) is mounted on the west wall of the house near the northwest corner. It is designed to trap the needles and light debris in its two layers of filter fabric, and to entrap heavier debris in the lower portion.



The 8" all-in-one debris pipe during construction and at completion

A leaf trap and 3" debris trap is mounted on the west wall of the house near the south west corner. The leaf trap (from Pro-tech Exterior Products in Victoria) removes the leaves and the majority of fir needles. A debris trap constructed of 3" PVC piping with a cleanout plug entraps the heavier particles.



The two debris traps along the west wall are connected by PVC catchment piping that runs just below final grade. This section of catchment piping also serves as a debris collector, and cleanouts are provided at both ends to allow seasonal or annual disinfection and cleaning.

All of the exposed piping has been primed with a PVC primer and painted. This lengthens the life of the exposed piping as well as improving aesthetics.

The rainwater from the west side of the building is carried around the corner; along the south wall of the house; past a cleanout, and connects to two 2" "Y" filters. Two inch piping connects the filters to the top of the surge/pump tank.

West side catchment piping, mesh screen filters and entry to surge/pump tank

2.3 First Flush Diverters

The house is equipped with a first flush diverter sized to reject the first 0.75 mm (0.3 inch) of water falling on the roof in every rain event. This type of device has been shown to remove up to 80% of the airborne pollutants that collect on the roof and become dissolved or suspended in the water running off the roof. This first flush of water through the gutters also removes much of the discolouration and acidity from contact with Cedar, Arbutus and Fir needle debris.



The first flush rejection quantity for this project is higher than the normal reject amount of 0.5 mm. to compensate for the asphalt shingle roof and the number of nearby trees.

This house is equipped with separate first flush diverter pipes for the two sides of the house because of the different elevations of the catchment piping.

Separate first flush diverter pipes from east and west catchment piping.

This type of first flush diverter has no mechanical or moving parts. The first water from the catchment pipe simply falls by gravity into the diverter pipe (solid arrow). When this pipe is full, the water in the catchment pipe flows past the entrance of the first flush diverter and on to the filters and the surge/pump tank (dotted line).

West side diverter drops down to grade from catchment piping



The separate first flush diverter pipes meet at the uphill corner of the surge/pump tank and, following the natural site slope, run through a shallow trench to the edge of the stream bank (approx. 25 linear feet).

Two First Flush Diverter Pipes and overflow in shallow trench (during construction [lef]) and after [right])

The end of the first flush diverter pipes are equipped with a plug end which should be left loosely screwed in to allow a drip rate sufficient to empty the pipe within 24 hours. This drip rate will diminish as debris fills the threads requiring periodic checking.



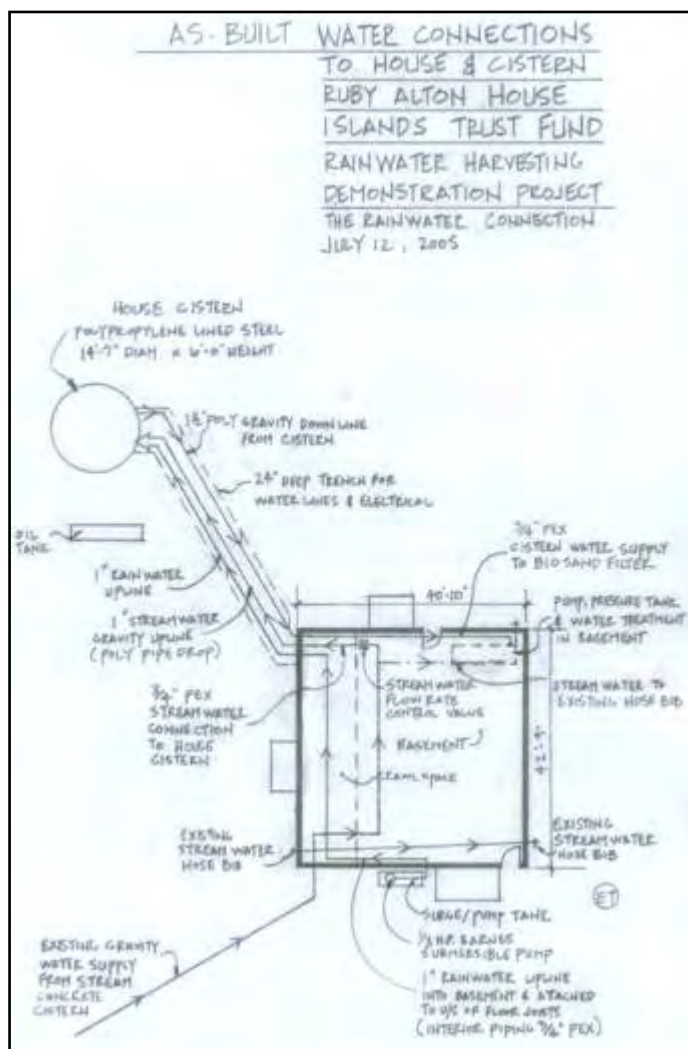
Full Roof Water Diverter

By removing the end plug, the first flush diverter pipe also functions as a diverter for all of the roof water at times when roof water should not be entering the tank; e.g. during pollen season or when the roof or gutters are being cleaned. For this reason the area around the end of the pipe is built up with rock and gravel to prevent erosion of the stream bank.

The end of the 2" tank overflow pipe from the surge/pump tank is also located in this location. Its end is screened to prevent rodents or insects from entering the tank.

2.4 Surge/Pump Tank

As shown on the *As-Built Water Connections to House and Cisterns Plan* dated July 12, 2005, the rainwater flows by gravity to a surge/pump tank, and is pumped up to the cistern.



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The surge/pump tank is a 175 Imperial gallon leg tank. The tank is partially buried next to the house foundation to minimize winter freeze up. It is supplied with a 2 inch overflow as this will be the main overflow for the system during a power outage and when the main cistern is full.

175 imp gal surge/pump tank showing water and electrical connections to house

A Barnes Submersible pump (SP33AX 1/3HP c/w cord set) is installed in the surge/pump tank which is capable of pumping over 10 gallons per minute at a 25 ft head. The pump's float switch is set to automatically turn it on when the tank is just over $\frac{1}{2}$ full and off when as close to empty as possible.

The pump is powered from an all season receptacle installed on a new electrical circuit. A float switch in the cistern has been set to disable this circuit when the cistern is full.



Barnes Submersible Pump in Surge/Pump Tank



One inch exit piping from the pump connects exits near the bottom of the tank. Flexible PVC piping then runs up and into the house basement. A T-fitting and tap (with blue hose) are provided just above grade to allow pumping the tank dry for cleaning.

Tap and blue hose allows easy emptying of tank for cleaning.

2.5 Rainwater and Stream Water Piping to Cistern

Rainwater

Rainwater from the surge/pump tank is pumped through the crawl space portion of the house basement (through $\frac{3}{4}$ inch pex piping) to the north west corner and connects to 1 inch poly piping running in a 30 inch deep trench to the cistern.



As shown on the *As-Built Water Connections to House and Cisterns Plan* dated July 12, 2005, this trench is also shared with a 1 inch stream water supply line and a 1 $\frac{1}{2}$ inch poly exit line supplying cistern water by gravity to the water purification equipment in the house basement. 110 electrical wire is also buried in this trench. The trench was backfilled with imported sand for approx. 1 foot, and native soil for the remainder.

Water and electrical lines run to cistern in 30" deep trench. Cross pipe is old ditch drain line.

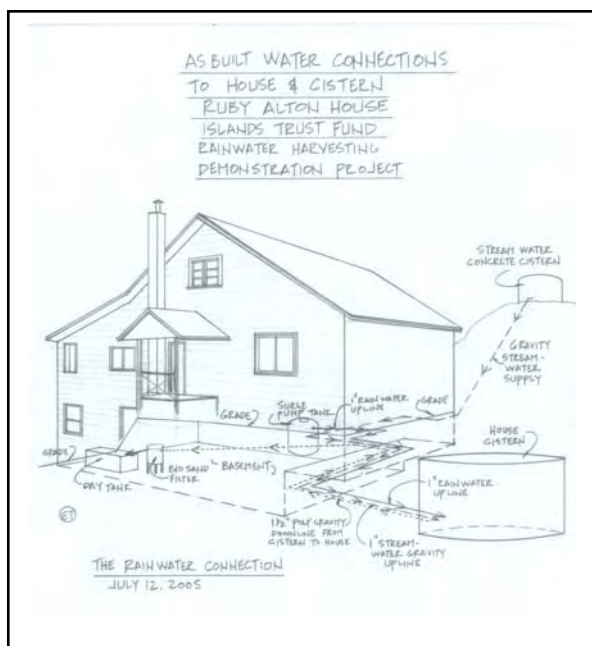


Electrical line and water lines backfilled with sand and native material

Stream Water

The existing stream water supply pipe is also connected to the new house cistern to provide an automatic supplementary water source with a manual override. The stream water and rain water systems are kept entirely separate, and provision is made in the cistern to prevent any possibility of backflow interconnection between the two water sources.

A new $\frac{3}{4}$ inch pex pipe connection has been made to the existing stream water supply line where it enters the house crawl space in the south west corner. The new $\frac{3}{4}$ inch line runs down the centre of the basement (south to north) and then to the northwest corner of the house. A $\frac{3}{4}$ inch valve is installed just after the pipe heads west towards the corner. This valve can be used to manually control the flow rate of the stream water or to shut it off. This water line and valve are clearly labeled.



A “T” connection near this point also provides stream water to an exterior tap on the north wall of the house. This augments the two existing stream water exterior taps at the south east and south west corners of the house.

At the northwest corner of the crawl space the $\frac{3}{4}$ inch pex connects to 1 inch poly pipe which goes through the wall of the house, into the trench and to the cistern.



Re-landscaping around the northwest corner where the water lines enter the basement

2.6 Water Supply to House

The water supply lines to the house have been altered so that all of the house water supply comes, by gravity, from the cistern. A new 1½ inch poly pipe runs from the cistern, through the trench to the northwest corner of the house and connects inside to a new 1 inch supply line that runs to the BioSand filter. Gravity water flow into the BioSand is limited by a float ball cock valve.

BioSand 120 and 1000 litre day tank



Ball cock valve controls flow into BioSand filter



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The water is processed slowly (approx. 120 litres or 26 gal per hour) through the filter and is collected into a 1000 litre (225 imperial gallon) day tank. Up to this point the water flow is by gravity. Water is pulled out of the day tank by the existing pressure pump (older model), and pressurized into the existing pressure tank that provides pressurized water to the water purification system and the house. The existing pump and pressure tank were reconfigured and the pump direct wired to a new dedicated 110 electrical circuit.

2.7 Cistern Construction



Water storage for the system is provided by a polypropylene lined steel cistern supplied and installed by the Rainwater Connection. This tank has been “stamped” by a BC Structural Engineer. This cistern is 14’7” in diameter by 6 feet tall with a nominal capacity of 28,370 Litres (6,240 Imperial gallons) and an operating capacity (with overflow set 3” below the top rim) of 27,200 Litres (5,980 Imperial gallons).

2.7.1 Cistern Pad

The cistern stands on a 16 foot diameter pad that has been compacted to over 500 pounds per square foot and leveled. An excavator removed the top 12” of poor bearing soil and approximately 14” of road base from SSI was then spread and compacted.



Removal of top layer of soil



...and adding new compactable fill



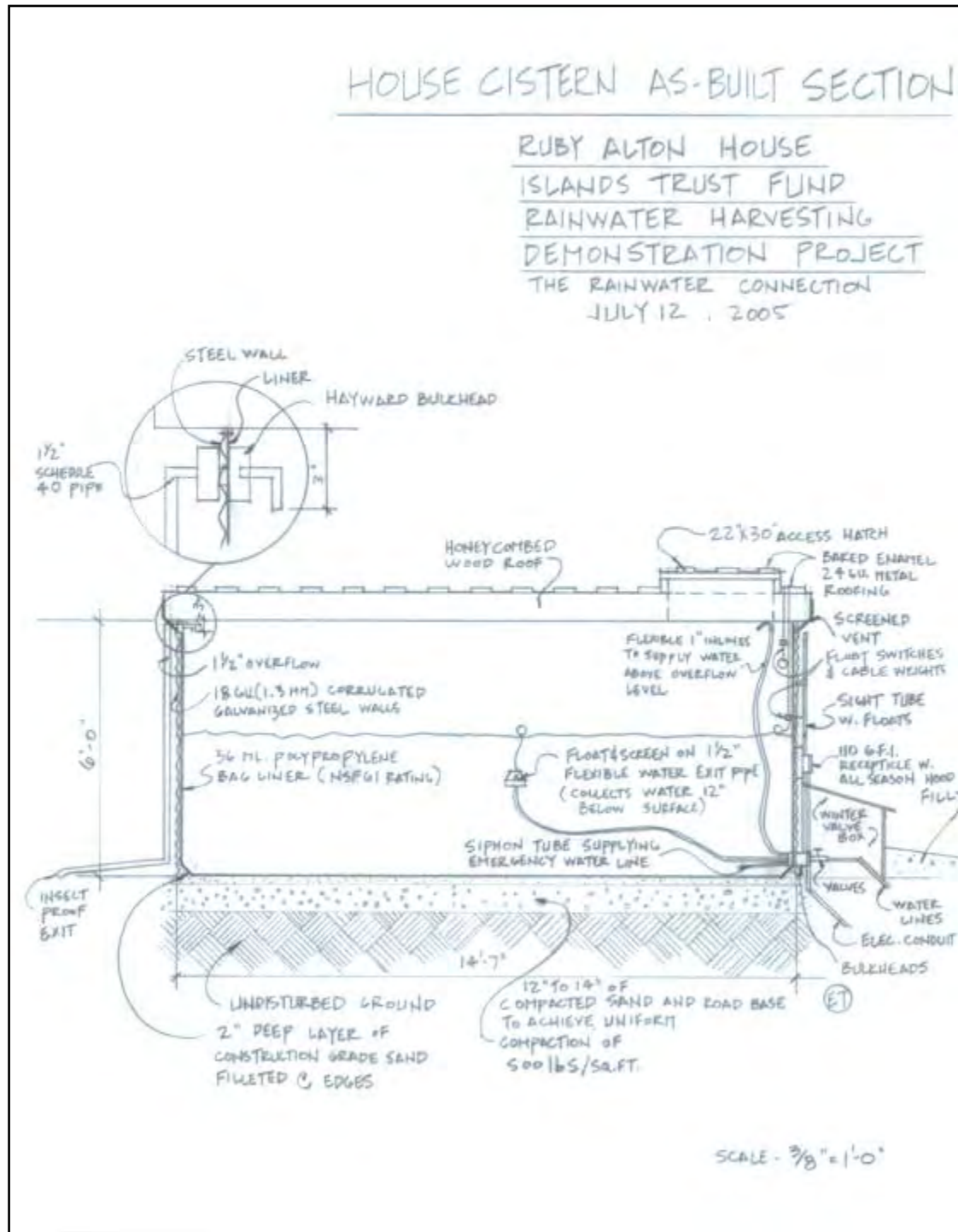
The site was also leveled and compacted by hand with a portable compactor, and the final sand layer was spread by hand.



Drainage to the rear of the tank was improved by digging out the ditch, adding drainage pipe, and backfilling with rock.

2.7.2 Walls and Liner

The construction details of the cistern are described in the *House Cistern As-Built Section*.





The cistern walls are constructed of bolt-on-site 1.3mm (18 gauge) galvanized, corrugated steel panels which are pre-bent and drilled at the Stelco plant in Hamilton Ontario.

Starting the first ring of a bolt-in-place tank

The exterior base of the steel panels is covered with an 18" wide circle of drain rock around the perimeter of tank to prevent sand and dirt spatter up the walls. The galvanized finish can be left as is and should have a lifetime of up to 50 years. Alternatively, the metal can be primed and painted with industrial quality paints, or 2 foot wide wood lattice can be hung from the roof overhang structure.



2 man crew and roof specialist build the tank in 2 ½ days

The prefabricated liner of 36 mill polypropylene with an NSF 61 rating is bag shaped and forms the bottom of the cistern. The top, reinforced hem of the liner is bolted to the top of the metal wall panels.



Cistern Roof

The roof is a honeycombed wood structure with a 24 gauge enamel metal roof designed to withstand local snow loads.

Roof structure built on a jig and transported to site in 5 sections



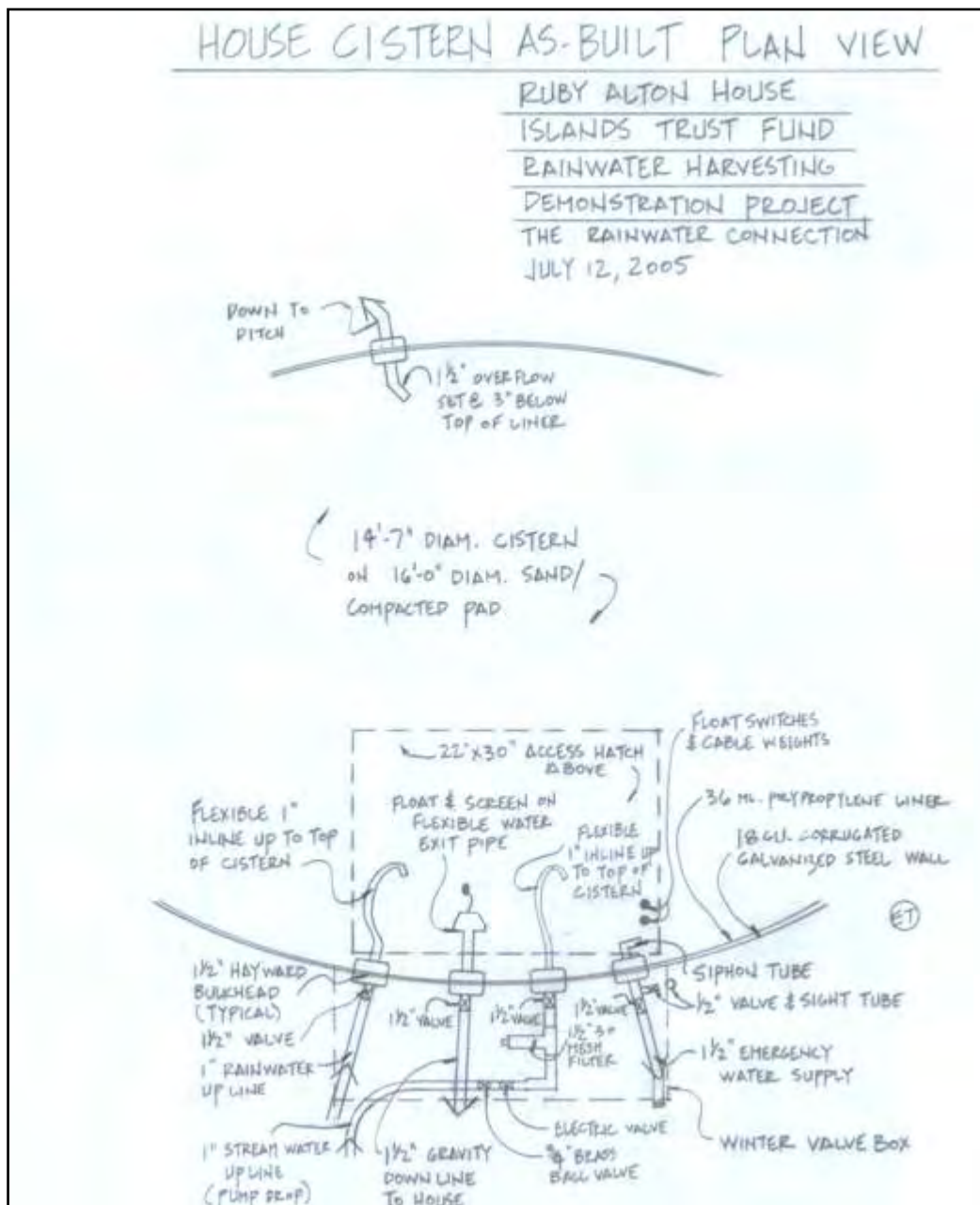


The roof is equipped with a 30 inch by 22 inch hinged access hatch with a safety hasp and padlock. The roof overhang detail allows for screened venting around the perimeter of the tank.

Screened venting at roof overhang

2.8. Cistern Fittings and Equipment

The Cistern fittings are described in the *Cistern As-Built Plan* view below.



2.8.1 Overflow

The cistern is supplied with a 1½ inch overflow set to start draining the tank 3 inches below its upper lip. The water runs through the tank liner and wall via a 1 ½ inch bulkhead designed for tank walls with liners. The exterior pipe runs down the rear wall of the cistern and away from the tank to drain into the ditch drain. Its end is equipped with screening to prevent mosquito or rodent access to the cistern.

2.8.2 In and Out Water Line



The cistern is supplied with 2 in-lines and 2 exit lines – all of which enter the tank through bulkhead fittings mounted 4 inches above the bottom. Each of these lines is equipped with a 1½ inch ball valve located immediately on the outside of the tank wall. This prevents water loss in the event that any of the water lines develop a leak or require repair.

2 in-lines and 2 out-lines enter the cistern near the bottom

The two in-lines to the cistern (rainwater and stream water) enter near the bottom of the tank; rise up the inside through flexible 1" pipe, and deliver the water above the water overflow level. This prevents accidental backflow of tank water out of these pipes, and their location inside the tank prevents winter freezing



Interior cistern fittings

There is no check valve or backflow preventer in the rainwater up-line. This allows drainback between pumpings from the surge/pump tank which eliminates any possibility of winter freeze up.

The stream water in-line is equipped with a 1½ inch screen mesh filter outside the tank. Its 80 mesh filter prevents the larger debris suspended in the stream water from entering the cistern.

This stream water line is separated horizontally by 2 feet from the rainwater supply line, and both terminate 3 inches above the tank overflow level. This results in simple mechanical separation of the stream and rainwater systems. The stream water flow into the tanks is controlled manually by in-line valves - two in the winter box immediately outside the cistern, and one in the house basement. It is also controlled automatically by a float switch and electronic valve described below.



As shown on the *House Cistern As-Built Section* (see above), two float switches are suspended in the cistern. Each is clearly marked. The rainwater float switch is set to turn off when the cistern is full. This disables the electrical circuit that powers the transfer pump in the surge/pump tank.

Float switches and cable weights

Electronic valve and mesh filter on stream water in-line



The second float switch controls the stream water supply. Set further down in the tank, this float switch opens the circuit when the cistern water level is less than half full and disconnects it when the water level reaches approximately 2/3 full. It is connected to an electronic water valve that opens to allow water flow when the circuit is connected (i.e. when the tank is less than ½ full), and closes when the electrical circuit is disconnected. This valve has a manual override which can be set to keep the valve open during an extended electrical power failure.

This float switch and electronic valve system allows automatic “topping” up of the cistern with stream water when the stored water level drops below one half. By cutting off the stream water supply at the two thirds mark it also ensures that there is excess tank capacity to receive rainwater. Depending upon precipitation and household water use levels, the stream water supply will likely be turned off manually during the winter, and the cistern will be filled entirely with rainwater. (See Section 3.1.2)

The 1½ inch house supply exit line exits the inside of the tank 4 inches above the bottom.

The interior exit of the 1½ inch emergency out-line is equipped with a siphon tube so that it will collect water from within 1 inch of the bottom of the cistern. The exterior end is 1½ inch male pipe thread for connection to an emergency fire pump or local fire department fitting for their pump truck.

2.8.3 Sight Tube Water Level Indicator

A “T” on the exterior of emergency water exit line is connected to a ½ inch valve and a clear vinyl sight tube up the tank wall to act as a water level indicator. The number of imperial gallons stored in the cistern is calculated by multiplying the number of inches of water by 86.7; e.g. 24 inches of water (up to the first line of bolts) indicates 2,080 imperial gallons of stored water.



The sight tube is equipped with a valve to prevent cistern water leakage if the sight tube fails. It is important that it be left in the closed position except when taking water level readings.

Winter box, sight tube and electrical outlet

2.8.4 Winter Box

Freeze up protection for all the in and exit piping and valves is provided by an insulated box and thermostatically controlled light combined with the heat sync function of the water mass in the cistern. An electrical outlet with an all season hood provides power for the winter light and any pumps or equipment required for tank cleaning.

2.9 Water Purification System

The dual barrier water purification system was supplied and installed by Tiger Purification Systems Inc. from Victoria. The first component of this system is a BioSand#120 slow sand filter that receives water by gravity from the cistern and processes it at a rate of 120 litres (26 gal.) per hour before it enters the 1000 litre (225 imperial gallon) day tank.

The BioSand filter is used to remove a host of potential problems from rainwater including parasitic cysts (e.g. Giardia and Cryptosporidium, bacteria, turbidity, taste, odour and colour.

This system will provide clear water for storage in the day tank, only requiring final disinfection in the distribution system prior to consumption.

Utilizing a gravity feed minimizes the power requirements for this type of installation.

The water enters at the top, flows through the quartz sand and exits out the bottom. It runs up the external pipe (see photo) and into the day tank through the clear flexible hose connection. The lower valve (partly closed in photo) controls the rate of flow out of the BioSand filter.



The final stage of the water purification system processes the pressurized water before it enters the house supply piping. The water runs through a water meter measuring in cubic meters (1 cu meter equals 1000 litres or 220 imp. gal.). It is then pressurized through a large capacity dual gradient particle filter equipped with a 50/05 micron filter cartridge. The final particle filter is supplied with a 10 micron Model CTO 4 ½ x 20 carbon block filter cartridge.



The last step in the water purification is an ultra violet light to kill coliform bacteria. A Trojan UVMAX D disinfection unit is installed. This “rural quality” UV light is designed to run consistently during power spikes and brown out conditions. It is equipped with an alarm and a self diagnosis monitoring system that provides a simple coloured light indicator of operational condition and code numbers that indicate the possible cause of any malfunction.

3. OPERATION AND MAINTENANCE

This section of the manual describes the operation and maintenance procedures for each of the components of the rainwater and stream water supply system, and the water purification system in the basement.

The maintenance tool kit and replacement parts supplied with the system are listed in Appendix B.

To ensure efficient operation and good quality water, the system requires monthly maintenance checks and cleaning of some components. These actions are described in this section and summarized in the Monthly Maintenance Checklist in Appendix C.

In addition, some components such as the roof and gutters require a full cleaning in the spring and fall, and others require annual or bi annual inspection. These actions are described in this section, and summarized in the Spring and Fall Maintenance Checklist in Appendix D.

Likely Maintenance Time:

Overall it should be possible to maintain the system according to these guidelines in 1-2 hours per month plus 4-5 hours in the fall for inspection and cleaning, and 6-7 hours in the spring.

3.1 Managing Your Water Supply

The Alton House water supply is a combined system where rainwater is provided to supplement the existing water supply from the stream. In a year with average precipitation levels rainwater catchment over a 12 month period will total almost 31,000 imperial gallons (141,000 litres). Using a storage cistern of approximately 27,200 litres (5,980 Imperial gallons) allows up to 61% of the total annual household water demand to be supplied. This assumes a water conserving use level of 151 litres or 33.3 Imperial gallons per person per day for a 4 person household. As shown in the water balance table in Appendix A (See May 25, 2005 report *Water Balance Table and Water Requirements*) the monthly use levels are assumed to be 18,400 litres (4,050 imperial gallons) for the winter spring and fall increasing to 20,700 litres (4,550 imperial gallons) for the 4 summer months June-Sept.

Using the above assumptions, the house could run entirely on the rainwater from November through January each year, but will require a total of 95,500 litres (21,300 gallons) of stream water to supplement the rainwater supply, and keep water in the cistern over the dry summer months.

3.1.1 Monitoring the Monthly Water Storage Amounts

The system is not designed to keep the cistern full at all times. Rather it is intended to always leave some space for rainwater inflow.

The projected amount of water in the cistern at the end of each month is shown in the left hand column of the water balance table in Appendix A. This is a useful guide, but the actual amount will vary if monthly rainfall is higher or lower than normal, or if household use differs from the assumptions.

To calculate the amount of stored water in the cistern, open the ½ inch yellow handled brass ball valve that allows water to rise up in the clear sight tube mounted on the side of the cistern. Measure the water height using the first row of bolts as a reference elevation. This row of bolts is 24" above the tank bottom.



The number of imperial gallons stored in the cistern is calculated by multiplying the number of vertical inches of water by 86.7.

For example 24 inches of water (up to the first line of bolts) indicates 2,080 imperial gallons of stored water. A month's supply of water in the summer (4,550 gallons) would require a water level of 52.5 inches.

CAUTION:

Close the valve after you have finished taking the water level reading. This is the weakest part of the storage cistern, and a break in the vinyl hose could drain the tank if the valve is left open.

3.2.1 Adding Stream Water to Maintain Monthly Requirements

This is a combined system, and consequently it is necessary to add stream water to the system at regular intervals. Stream water can be added manually or automatically.

Manual Addition of Stream Water:

Water from the stream water supply line can be added by opening any one of three valves on the stream water supply line – two located in the winter box next to the cistern and one in the house basement which is clearly labeled.

The valve must not be fully opened – but rather just “cracked” open (approx. 5-10 degrees) to allow a slow flow of water to the tank. The flow rate should not exceed 0.5 gal per minute, and this can be checked by opening the cistern hatch and measuring the water flow rate or just observing the water action. This flow rate will appear as a constant flow that falls vertically as soon as it leaves the pipe exit.

Leaving the valve open with this flow rate will add approx. 30 gallons per hour to the tank or 700 gallons per 24 hour day.

Automatic Monthly “Topping-up” Procedure:

The system is equipped with a float switch and electronic valve system that allows automatic “topping” up of the cistern with stream water when the stored water level drops below one half – i.e. below 3,000 gallons. When water is below the 3,000 gallon level the float switch opens the electronic valve located in the winter box and allows stream water to flow into the tank. When the water level reaches two thirds of tank capacity (approx. 4,000 gallons) this same float valve turns off the electronic valve and prevents more water from entering the tank. This ensures that there is excess tank capacity to receive rainwater.

To activate automatic filling, open the stream water supply valve as described above under manual filling procedure. The float switch will turn off the flow when required.

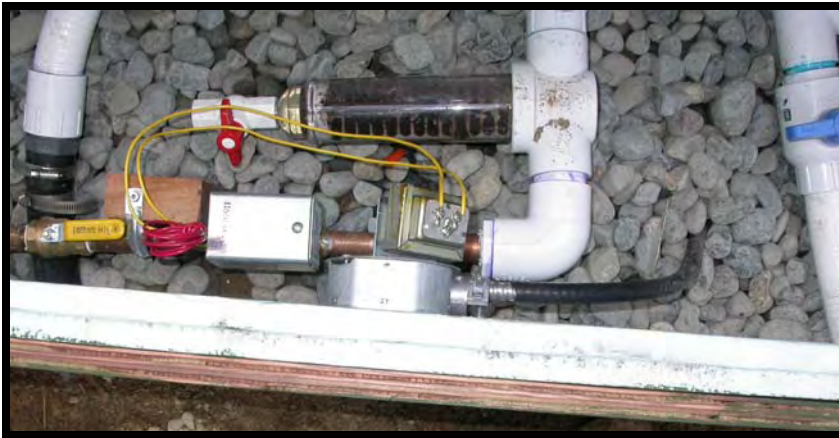
Recommended Monthly Filling Procedure:

The following cistern filling or “topping up” procedure is recommended to ensure that as much as possible of the higher quality rainwater is used, and to minimize summer use of the limited stream water supply.

- November through January should require no additions of stream water.
- If the cistern water level is below 2,000 gallons you may wish to add water in one day increments using the manual fill procedure – but to

improve overall water quality, do not exceed a water level over 3,000 gallons.

- Use the automatic filling procedure February through June to start to build the cistern water level. This will become especially important when the roof top collection system is shut down in April for pollen season (see Section No. 3.2.1)
- In late June the tank may be filled right to the top with stream water by setting the manual override switch on the electronic valve to “on”, and letting the water run till the water level is three inches from the top of the tank. This is an optional procedure which can be used to reduce demand on the stream water supply in the following two months. It is important however to remember to turn the automatic valve to “off” before the tank starts to overflow.



- Use the manual filling procedure July through September to reduce the demand on the stream water. The tank could be manually filled at the beginning of each month to a level of 4,500 gallons – a one month supply. Topping the tank up to 2,000 or 2,500 gallons twice per month would provide even less stress on the stream water supply.

3.1.3 Checking for System Leaks

It is recommended that the system be checked for leaks once per year. This procedure should be carried out during a period when no rain is expected for 5 days. The following steps are required.

- Ensure that there is a 7 day supply of water in the main cistern.
- Close all the stream water supply valves.
- Turn off the transfer pump electrical circuit at the breaker box.

- Record the time and date and the amount of water in the cistern.
- Record the time and date and the water meter reading in the basement.
- After 5 days (approx. 120 hours) record the amount of water in the cistern and the water meter reading.
- Restart the system
- Compare these two measures of water use over the 5 day period. If they are within 5% it can be assumed that the system is leak free. If the result shows a higher variation call the Rainwater Connection for further test methods and ways to check the system.

3.2 Roof and Gutters

Roof and gutter cleanliness is the most important contributor to high quality rainwater. It is recommended that the roof and gutters be checked and lightly cleaned every 4-6 weeks during the spring, summer and fall, and that they be thoroughly cleaned twice per year – after pollen season in the spring, and in late October or early November after most of the leaves and needles have stopped falling.

3.2.1 Pollen Season in South Western British Columbia

Every spring as the trees bud, they release a fine pollen that can blow for considerable distances. Each species of tree has its own distinct pollen, flower, seed and berry characteristics, and the release times vary. Typically the alder and maple pollen comes first – as early as the middle of March, but generally in late March or early April. These pollen types are generally not as dense and “sticky” as the fir pollen which typically starts mid April.

The amount of pollen varies each year and the amount landing on a particular roof will vary depending on the proximity of trees, the prevailing winds and the amount of rain. The amount of pollen in the air can be identified by laying a flat shiny surface such as glass horizontally on a table and observing the residue that collects. This also helps to determine the “stickiness” of the pollen in your area.

Pollen is composed of extremely fine particles that coat the roof, the catchment pipe interiors and can clog the gravity filters. In most systems some pollen will find its way through the catchment system into the cistern. It is preferable to prevent pollen from entering the cistern, because a portion of it stays suspended in the stored water and encourages the growth of algae and other organisms.

Most rainwater collectors in southern British Columbia stop collecting rainwater during the pollen season, and undertake their annual spring cleaning of roof, gutters and catchment piping when the pollen has stopped falling.

CAUTION:

Before cleaning the roof or gutters with water, open and remove:

- o ***the debris pigtail plugs,***
- o ***the plastic filter inside the 4" high capacity filter***
- o ***the screen inside the gravity screen filters, and***
- o ***the first flush diverter end plugs.***

This ensures that none of this contaminated water reaches the surge/pump tank.

3.2.2 Roof Cleaning Procedure

- The shingle roof on Alton House is of unknown age and the surface is irregular which allows needles and debris to build up. The roof must not be subjected to heavy brushing which would further disturb its surface.
- It should be blown clean or lightly brushed whenever the needles or other debris build up enough to be clearly visible from the ground. Special attention will probably be required in late Sept and Oct. when the fir trees are shedding their needles, and the Maple trees are shedding their leaves.
- The roof will require a full cleaning in spring and fall. These cleanings should consist of:
 - o Removing any moss build up by hand,
 - o Light brushing and a thorough blowing with the leaf blower
 - o A final rinse with pressurized water from a hose nozzle –especially in the spring after pollen season.
 - o For best results let the first good rain further rinse the roof before the system is restarted to collect rainwater.

3.2.3 Gutter Cleaning Procedure

The gutter cleaning procedure should be as follows.

- Blow out debris in the gutters when debris is being blown off the roof.
- Hand cleaning with a wet rag may be required when debris build up on the bottom of the gutter is not fully removed by air blowing.

- Use a brush and rag to hand clean the gutters after the spring and fall roof cleaning. A pressure washer may be used but extreme care is required to prevent accidental damage to the lower row of shingles.
- If gutter guard is installed the guard surface should be air blown when the roof is blown clear. The guard should be removed and the gutters hand cleaned in the spring and fall. It is also recommended to check and possibly remove the guard and clean the gutters in June and again in the early fall to improve the quality of water collected during September and early October.

SAFETY WARNING

The roof is too steep for a person to safely walk on it for purposes of hand or machine cleaning. A safety harness and rope attached to the chimney should be used at all times.

The gutters on the east side are a full two stories above grade. A tall ladder can be used, but given the height and poor ladder footage on the sloped backyard, it is recommended to service them from the roof using a safety harness.

3.3 Debris Traps

There are four types of leaf and debris traps on the Alton House rainwater demonstration project. The following describes the operation and maintenance procedures for each type.

3.3.1 Pipe Debris Pigtails

Two debris trap pigtails constructed of 3" PVC piping are included in the system – one long one at the south east corner of the house, and one short one under the leaf trap at the south west corner. (see As-Built Plan of Rainwater Catchment System in Section 2.2).

Their function is to trap some of the heavy debris coming down the downspouts.



The plug ends of the debris traps should be tightened by hand. They will drip slowly – and they are meant to. The water loss over time is very small. Initially the leak rate may be more than a drip, and in this event the plug should be removed; the threads cleaned with a small brush (e.g. a toothbrush or tile grout brush) and tightened firmly. Within a short time the debris will fill the threads and the drip rate will diminish. Over time the debris will fill the threads and the dripping will stop. This is not desirable because the pigtail then becomes a depository of stagnant water, and in the winter, a full debris trap is subject to freezing and cracking.

The debris pigtails should be inspected and cleaned every month. This is best done after a rain when they are full. The plug should be removed (avoid the water spurt), the pipe cleaned with a 3" toilet brush, and the threads cleaned with a small toothbrush or tile grout brush. Some people like to spray in a solution of water and bleach (1 part bleach to 10 parts water), but this is not required.

CAUTION:

It is especially important to check the dripping function of these debris pigtails in the winter during freezing conditions. If the end plug is not dripping, the water build up in the pipe can freeze and damage the piping.

3.3.2 All-in-One Debris Pail

Alton house is equipped with one All-in-one Debris Pail which is designed and manufactured by the Rainwater Connection. This 8 inch welded steel device is powder coated for durability and carries a 2 year warranty.

Virtually 100% of leaves, needles, and light debris are trapped in the two layers of furnace filter fabric, and heavier black organic debris is trapped in the bottom portion of the pail.

The filter layers must be removed and cleaned every month – possibly more often at times when large amounts of debris are deposited on the roof and are flowing through the gutters and downspouts. Cleaning is a simple process of shaking the debris out of the filter material. Depending on conditions, the filter material will break down and become less effective and difficult to clean after 3-6 months of use. Four replacement filters are provided with the Debris Pail and more may be ordered through the Rainwater Connection.





The debris pail is installed on two retaining screws, and can be lifted up and removed for a complete cleaning. This should be done every two to three months. Empty out the dirty water trapped in the bottom; remove the filters and the grate, and flush out or hand clean the interior. This will add to the life of the debris trap and improve water quality.

Lower Chamber of All-in-One Debris pail

3.3.3 Leaf Trap with Debris Pigtail

A simple leaf trap combined with a pipe debris pigtail is located near the south west corner of the house. This leaf trap portion is manufactured by Pro-tech Exterior Products in Victoria.

Experience has shown that this device will trap most leaves and berries, and a good proportion of the fir needles. It is designed to be self cleaning although the occasional hand brush out of accumulated debris can improve its effectiveness.

It should be cleaned with a spray of water occasionally during the year – usually when the pipes are being cleaned.

The pipe debris pigtail below the leaf trap will trap heavier organic debris as well as some of the fir needles that get through. Its maintenance is described above in the Pipe Debris Pigtails section.



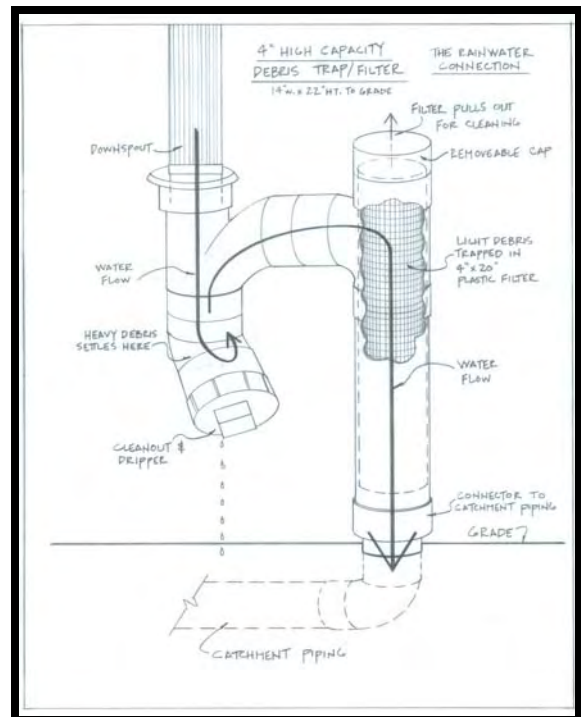
3.3.4 High Capacity 4 Inch Debris Filter

A high capacity 4 inch debris filter is installed on the south wall of the house near the surge/pump tank. A durable plastic filter is installed inside the 4 inch PVC pipe which will entrap virtually all large debris including fir needles.

This filter should be checked every two months and cleaned if significant amounts of debris have collected. It is particularly important to clean it after pollen season, and to check it again in the early summer, and again in the early fall (Sept.-Oct.) when the fir trees are shedding their needles.

To clean the filter remove the 4" end cap and pull up the green handle forming the top of the filter. The handle has to be rotated about a quarter turn to release it. The filter is best cleaned with pressurized water from a hose nozzle and the toilet cleaning brush. To prevent bacteria build up in the summer it is recommended that the filter be sprayed with a solution of water and bleach (1 part bleach to 10 parts water)

This filter is manufactured by the Rainwater Connection and has a two year warranty. Contact the Rainwater Connection for repairs or replacement filters.



3.4 Cleaning the Catchment Piping

The catchment piping is the 3 inch diameter PVC piping which carries the Rainwater from the debris traps to the gravity mesh filters. The two major runs are along the south wall of the house, and underground along the west wall. These locations are shown on the As-Built Plan of Rainwater Catchment System in Section 2.2.

These sections of catchment pipe are sloped just enough to ensure water flow, but are intentionally installed at a low slope to facilitate fine particles carried in the water to drop out and be deposited in the bottom of the pipe. Consequently, it is important to clean these pipes periodically, and three cleanout plugs (see Rainwater Catchment Plan) have been provided for this purpose.



Pipe cleaning brush and "snake"

The underground pipe along the west wall should be cleaned in the spring and fall. Both sections of the exposed catchment pipes along the south wall should also be checked once or twice during the summer months because they are exposed to the sun which can foster the growth of bacteria. Open the plug, and if any smell is detected the pipe should be cleaned.

The pipe cleaning procedure is as follows.

- Remove the gravity mesh filters to prevent any water from entering the surge/pump tank. (see Section 3.5)
- Open and remove the plug ends from the first flush diverter pipes.
- Open the cleanout plug in the catchment pipe with a small adjustable wrench.
- Add a small amount of water into the uphill end of the pipe to be cleaned (ideally this procedure is done when it is raining).
- Push the brush attached to the plumbers snake (provided by the Rainwater Connection) into the pipe. With a gentle back and forth motion push the cleaning brush all the way to the end of the pipe section, and pull it slowly back out – once again using a back and forth motion.
- Flush the pipe with water and approx. ¼ cup of bleach.
- NOTE:
Alternatively, but only where no bleach is being used anywhere in the system, a heavy duty cleaning solution of hydrogen peroxide may be used. This is the preferred cleaner in many situations because it breaks down into water and oxygen. Oxy Jan is a 7% solution of Hydrogen Peroxide sold at Janitors Warehouse stores. 6-10 oz. of this product mixed into 1 gallon of water provides a heavy duty cleaning solution.
- Repeat the brush cleaning (with water flowing) after the initial flushing with bleach or hydrogen peroxide.
- Rinse the pipes with another 5 to 10 gallons of water if it is not raining. If it is raining let the pipes flush with rainwater for 30 minutes to an hour.
- Replace the filters and plug ends to restart the catchment system.

SAFETY WARNING

With either bleach or Hydrogen Peroxide avoid contact with eyes or skin. In case of contact, flush promptly with abundant water.

Harmful if swallowed.

Read and follow the manufactures instructions on the container.

Both cleaners can mark clothing.

NEVER use bleach and hydrogen peroxide together because they can react to create a noxious gas.

DO NOT use any other type of household cleaner which may contain soap or other chemicals which could affect the quality of the collected water. For example do not use household bleaches with additives for smell or “whitening”.

3.5 Gravity Mesh Filters

The four 2 inch polypropylene and stainless steel mesh strainers or filters provide the final cleaning of the roof water before it enters the surge/pump tank. The system is equipped with two filters on each of the catchment pipe water supply lines; i.e. the catchment pipe from the east roof and from the west roof. The first (upstream) filter canister contains a 30 mesh screen (yellow) and the second an 80 mesh (blue) screen. Working in series they entrap particles larger than 175 microns in size.



It is important to clean these filters on a regular basis to improve water quality and to ensure that they do not become clogged up and cause the water to back up in the catchment piping. Monthly cleaning is recommended for the filters in this system. More frequent checks should be made at times of heavy debris concentrations on the roof, and during the high volume rainfalls during the winter months. These filters can also provide a place for bacteria growth, so more frequent checks are recommended during the summer where the filters are exposed to sunlight.

The gravity flow of the roof water is slowed down by these filters which results in increased sedimentation at the entrance to the filter and in the piping just before it. This piping should be cleaned whenever the catchment pipe is being cleaned (see Section 3.4 above) and when the filter mesh is being cleaned.

The filter cleaning procedure is as follows.

- Unscrew the lower portion of the black filter housing and remove the stainless steel mesh screen.
- Clean the mesh screen under a tap or hose using a 2 or 1 ½ inch bottle brush (available at kitchen stores or any wine making establishment).
- Insert a 1 ½ inch bottle brush up into the filter housing to clean the upstream section of 2" piping. Access to this piping is also provided by a 2" cleanout plug on the catchment pipe coming from the south east corner of the house.
- Clean out the lower housing of the filter with a brush and water. A mild solution of bleach and water can be used.
- Replace the mesh screen into the lower housing ensuring that the rubber ring seats squarely.
- Screw the lower filter housing and mesh screen back into the filter. It should be strongly hand tightened to prevent dripping.

CAUTION:

DO NOT use hydrogen peroxide or any other cleaning agent on the mesh screen or filter housing. These can reduce the longevity of the stainless steel in the mesh screens.

Winterizing Note:

These filters are equipped with a small dripper or cleaning plug on the bottom of their housing. Opening these fully does not provide a thorough enough cleaning even when water is flowing through them. However, it is recommended that these plugs be loosened during freezing weather to allow a slow drip. This prevents freezing of the water trapped in the housing which can damage the stainless steel mesh screens.

3.6 First Flush Diverters

Alton house is equipped with two first flush diverters sized to reject the first 0.75 mm (0.3 inch) of water falling on the roof in every rain event. This system is equipped with separate first flush diverter pipes for the two sides of the house because of the different elevations of the catchment piping. One pipe discards the first flush from the east facing roof, and the second one deals with water from the west facing roof.

It is very important that the first flush diverters be maintained to operate correctly because this type of device has been shown to remove up to 80% of the airborne pollutants that collect on the roof and become dissolved or suspended in the water running off the roof. This first flush of water through the gutters also removes much of the discolouration and acidity from contact with Cedar, Arbutus and Fir needle debris.

This type of first flush diverter has no mechanical or moving parts. The first water from the catchment pipe simply falls by gravity into the diverter pipe. When this pipe is full, the water in the catchment pipe flows past the entrance of the first flush diverter and on to the filters and the surge/pump tank (see description in Section 2.3). The separate first flush diverter pipes meet at the uphill corner of the surge/pump tank, and following the natural site slope, run through a shallow trench to the edge of the stream bank (approx. 25 linear feet).

The end of both first flush diverter pipes are equipped with a plug end which is left loosely screwed in to allow a drip rate sufficient to empty the pipe within 24 hours. This drip rate will diminish as debris fills the threads, and requires periodic checking. An alternate plug is also provided with a 3/32" hole. This can be used to provide a more consistently reliable drip rate.

NOTE:

It is important that the drip rate be checked periodically to ensure that the pipe empties within approx. 24 hours after a rain event. If it is emptying more slowly the pipe will not have sufficient capacity to reject the first flush from the next rain event. If it is emptying too quickly the system is discarding more useable water than necessary.

The drip rate from the First Flush Diverters can be measured using the following procedure.

- After the start of a rain event or just after the rain has stopped observe the flow of water coming from the end of the pipes near the stream bank.
- The correct drip rate will appear more like a small stream than an intermittent drip.

- Using a measuring cup, collect and measure the amount of water dripping out of the threads and the hole over a 1 minute period.
- The first flush diverter for the larger east roof has a capacity of approx. 17 imp gal or 78 liters. It should have an average drip rate of 54 ml per minute (about ¼ cup) to empty the pipe in 24 hours. The rate will be higher when it is full and slower as it nears empty.
- The diverter for the west roof has a capacity of approx. 9 imp gal or 41 liters. . It should have an average drip rate of 28 ml per minute (about 1 fl oz) to empty the pipe in 24 hours.

Cleaning the First Flush Diverter End Plug:

- If the plug end with a hole is being used, insert a pipe cleaner or metal meat skewer into the hole to remove accumulated debris.
- If the solid plug end is being used and the drip rate is too slow, the plug threads need to be cleaned. Remove the plug end (avoid the water spurt), and clean the nearby pipe with a 3" toilet brush, and the threads with a toothbrush or tile grout brush.

Cleaning the First Flush Diverter Pipe:

Over time the first flush diverter pipe can become extremely dirty with deposited debris. It should be checked annually and cleaned if debris has accumulated to a depth of ¼ inch near the end plug, or if there is a distinct odour. The cleaning procedure is similar to that for cleaning the catchment piping – see Section 3.4.

Alternative Winter Operation Procedure:

Rejecting the first flush during the winter rains when the water is running at its cleanest is not as crucial as during the other seasons when there is more debris on the roof and a greater period between rain events for pollutants to accumulate. Consequently, some rainwater collectors prefer to leave their first flush diverter pipes plugs closed most of the time during the winter, and manually empty the pipe once per week by removing the plug end and flushing the pipe empty.

3.6.1 Full Roof Water Diverter

By removing the end plug, the first flush diverter pipe also functions as a diverter for all of the roof water at times when roof water should not be entering the surge/pump tank; e.g. during pollen season or when the roof, gutters or catchment piping are being cleaned. For this reason the area around the end of the pipe is built up with rock and gravel to prevent erosion of the stream bank.

3.7 Surge/Pump Tank

3.7.1 The Tank and Overflow

The Alton House rainwater catchment system is equipped with a 175 imp gal polyurethane surge/pump tank. It was supplied by Isles West Water on Salt Spring Island and carries a ten year warranty. See Section 2.4 for descriptive photos.

The tank has a 16 inch diameter inspection/servicing hatch to allow easy access for servicing the pump or cleaning the tank. The 6 inch inspection cover in the middle of this hatch cover is equipped with two small vents. A blue fabric cloth (similar to that used in the all-in-one debris pail) has been inserted into these vent openings to prevent spiders and mosquitoes from entering the tank. This fabric cloth should be checked once per year, and cleaned or replaced if necessary.

The tank is equipped with a 2 inch overflow that runs to the stream bank in the same trench as the first flush diverter pipes. The pipe exit is covered with screening to prevent insects or small rodents entering the tank. This screening should be checked once per year to ensure that it has not become clogged with debris from overflowing water.

Sanitizing the Water in the Surge/Pump Tank:

The surge/pump tank is an excellent location to add a disinfectant to the rainwater to reduce bacteria and viruses. As described above, the water entering the surge/pump has been cleaned by the debris traps, catchment piping and gravity filters. However, the water reaching this tank will still contain suspended and small solid particles, and possibly some bacteria. Chlorine added here will help to sanitize the water entering the cistern, but its concentration will be low enough that no residual chlorine will accumulate in the main cistern. Chlorine in this water will also control algae growth in the surge/pump tank.

To add chlorine to the surge/pump tank it is recommended that a floating chlorine dispenser be attached to a thin rope tether and allowed to float in the surge/pump tank. The length and location of the tether rope must be adjusted to ensure that it will not get tangled in the float switch of the pump. Being careful to wear gloves, place the chlorine tablets in the dispenser.

It is recommended to use Calcium Hypochlorite which contains up to 65% chlorine. These come in stabilized versions (added calcium) which slows the release rate. Brand names include HTH or BioCL. These dispensers, and the chlorine tablets designed to fit into them, are sold at any swimming pool or spa store.

It is recommended that no more than 2 tablets be placed in the dispenser at one time. Depending on water quality and volumes passing through the tank, two tablets should last for up to two weeks. Adding more at a time could result in residual chlorine building up in the cistern.

SAFETY WARNING

Keep the inspection hatch closed at all times to avoid the possibility of small rodents entering and drowning in the tank.

Chlorine is corrosive, and a skin and eye irritant. It also stains clothing.

Avoid contact with eyes or skin. In case of contact, flush promptly with abundant water.

Harmful if swallowed.

Read and follow the manufacture's instructions on the container.

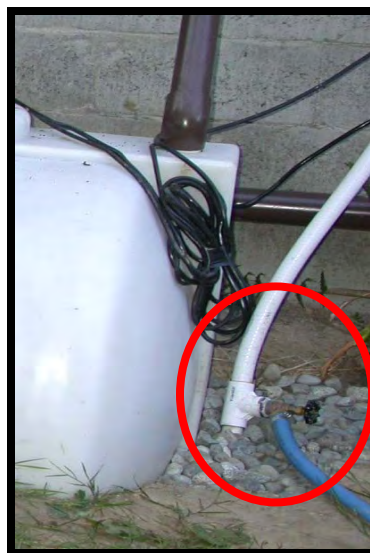
DO NOT use any other type of household cleaner which may contain soap or other chemicals which could affect the quality of the collected water.

Cleaning the Surge/Pump Tank:

The automatic pumping system from this tank does not fully empty the tank between pump ups. The residual water can become old and stale - especially during the summer when there can be long periods between rain events. If chlorine is used regularly the tank will only require cleaning twice per year (in the spring and fall). If chlorine is not used the tank will require monthly emptying and cleaning during the summer to control algae growth.

The procedure for emptying and cleaning the surge/pump tank is as follows:

- Open the hose bib fitted to the 1" water exit pipe from the tank, and direct the blue hosing onto the grass or into a bucket for disposal on the driveway.



- Open the access hatch, remove the chlorine dispenser, and manually turn on the pump by lifting up the float switch. The pump will start and the water will flow out the blue hose
- Continue pumping till the pump no longer moves any water. Immediately drop the float switch to turn the pump off
- Close the hose bib
- Some water will flow back into the tank. Remove the rest with a sponge or cloth. A wet dry vacuum can also be used.
- When most of the sediment and any trace of algae is removed, spray the bottom of the tank with a mixture of 1 part household bleach to 10 parts water.
- Reinsert the chlorine dispenser and close the hatch securely.

CAUTION:

Do not allow the pump to run dry for more than 30 seconds. Damage from overheating can occur with extended periods of operating without a flow of water

SAFETY WARNING

DO NOT use any type of cleaner in the surge/pump tank other than chlorine. Other cleaners may contain soap or other chemicals which could affect the quality of the collected water, or chemically react with the chlorine.

3.7.2 The Submersible Pump and Exit Piping

A Barnes Submersible pump (SP33AX 1/3HP c/w cord set) is installed in the surge/pump tank. The pump is equipped with its own float switch which has been set to turn it on when the tank is just over ½ full, and off when as close to empty as possible. The pump is off when the float switch is pointed down, and it turns on when the float switch is pointed up.

The pump's main electrical chord plugs into the back of the float switch electrical chord plug, and this is then plugged into an all season receptacle on the wall of the house. This wall receptacle is the only plug on an electrical circuit dedicated to running the pump.

NOTE: A float switch in the main cistern has been set to disable this circuit (and thus shut off the pump) when the cistern is full. This feature ensures that when the cistern is full, roof water will overflow out of the surge/pump tank

rather than out of the cistern overflow where site drainage is somewhat restricted.

This pump was supplied by Water Tiger Purification Systems Inc. in Victoria, and carries a 1 year warranty. Other than occasional checking and cleaning of the water intake screen on the bottom, the pump requires no servicing.

The pump rests on the bottom of the surge/pump tank and is connected with 1" flexible piping to a tank bulkhead located near the bottom of the tank. The pump can be removed for servicing by unscrewing the union fitting, and freeing the power cords.

SAFETY WARNING

Unplug the pump from the wall before removing it for servicing

Outside the tank, the one inch piping goes through the wall of the house and connects to the rainwater supply line to the cistern. This water line and the stream water supply line are described in Section 2.5.

3.8 Cistern Structure

Water storage for the system is provided by a polypropylene lined steel cistern supplied and installed by the Rainwater Connection. This tank has been "stamped" by a BC Structural Engineer – *AAE Structural LTD, Duncan, BC*. This cistern is 14'7" in diameter by 6 feet tall with a nominal capacity of 28,370 Litres (6,240 Imperial gallons) and an operating capacity of 27,200 Litres (5,980 Imperial gallons) with the overflow set 3" below the top rim. See Section 2.7 for a full description.

3.8.1 The Walls

The bolt together steel wall panels are manufactured to the specifications of the Rainwater Connection, and installed by them. The wall structure has a two year warranty.

The corrugated steel walls are heavily galvanized with a high zinc content and could last 50 years in an above ground installation. The finish can be left as is, and requires no maintenance.



An 18" wide circle of drain rock has been installed around the bottom perimeter of the tank walls. This prevents rain spatter depositing dirt on the metal wall surface. To help prevent premature rusting of the lower wall panels, it is recommended that this drain rock circle be maintained in a clean state.

The steel surface of the tank walls may be painted. An industrial grade primer and paint is recommended. Contact the Rainwater Connection for the most recent information on paint product options. A wood trellis can also be attached to the roof structure if desired.

3.8.2 The Liner

The prefabricated (factory welded) 36 mi polypropylene liner is bag shaped and forms the bottom of the cistern. The material carries the United States NSF 61 rating for potable water. The top reinforced hem of the liner is bolted to the top of the metal wall panels. It can be removed for repair or replacement without affecting the structural integrity of the tank.

The tank liner material is strong and flexible which suits it to the varying water pressures as the tank fills and empties. The liner material is rated for 20 years in a 2 foot deep pond with full exposure to the UV effects of the sun. Its lifetime in this application is unknown because the material has only been developed for 13 years. Similar liners in similar tanks in Hawaii have performed well over this time period, and show no signs of deterioration.

The liner was manufactured to the specifications of the Rainwater Connection, and installed by them. It carries a two year warranty.

CAUTION:

Like any liner it can be punctured by sharp, heavy objects - even objects falling down through the water. This type of liner damage is not covered by the warranty.

Take care to remove sharp objects from pockets when opening the hatch to service float valves or observe water condition.

Do not leave sharp or heavy objects such as power tools near the hatch opening.

Never push a sharp ended object or pipe into the water for any purpose.

Untrained personnel must not enter the tank for any reason. The tank accessories and water lines have been designed to be serviced from the top hatch thereby removing the need for the owner or maintenance people to enter the tank. If the tank liner needs cleaning or servicing call the Rainwater Connection or a reputable tank lining cleaning specialist who is familiar with the safety procedures for working inside tanks, and who will warrantee their work. The Rainwater Connection is trained in using a patching material that allows small repairs on site. Larger perforations may require removal of the liner and factory re-welding.

The liner bottom should be cleaned when the sediment level on the bottom gets to be 1 inch deep. Given the rainwater water cleaning devices built into the Alton House catchment system, the sediment build up in the tank should be minimal if the stream water is clear of sediment. It is anticipated that the liner will need cleaning at ten year intervals.

3.8.3 The Cistern Roof

The water tank roof consists of a honeycombed wood structure covered with 24 gauge enamel metal roofing. To ensure the longevity of the metal roof material it is recommended that the roof be brushed clean once per year.

The roof overhang detail allows for screened venting around the perimeter of the tank. This venting should be checked annually to ensure there are no perforations or loose areas which could allow mosquito access to the stored water.

The roof is equipped with a 30 inch by 22 inch hinged access hatch with a safety hasp and padlock. This should be kept locked at all times. The owner has been provided with two keys, and the Rainwater Connection retains one copy in its file.



SAFETY WARNING

This tank qualifies as a confined space. The air inside may not contain sufficient oxygen to maintain consciousness. Never enter the cistern without a respirator, and follow all of the other current regulations of the WCB.

This tank is often filled with sufficient water for a person to drown in. Keep the access hatch locked except when servicing, and never leave an unlocked tank unattended.

As a further precaution, never leave a ladder in place which could provide access to the tank roof.

3.9 Cistern Fittings and Winter Box

The cistern fittings are described in Section 2.8. Maintenance requirements for these components are listed below.

3.9.1 Screening on Overflow Pipe

The screening on the end of the overflow should be checked annually, and cleaned or replaced if sediment has collected.

Ensure that the drainage path at the end of this pipe remains unobstructed.

3.9.2 Filter on Stream Water In-Line

A 1/12 inch Rusco 80 mesh screen filter is installed on the stream water in-line just after the electronic valve, and before the main valve into the cistern. Its function is to remove sediment from the stream water before it gets into the cistern. Depending on the water quality of the stream water this filter could require cleaning as often as every two weeks. If it becomes overly full of sediment the filter will restrict, or even stop, the flow of stream water into the cistern. (see photos in Section 2.8.2)

When water is flowing through the filter it can be partially cleaned by opening the red ball valve close to its end. The water flow out the end will partially flush out accumulated debris. This cleaning process is most effective if the valve is opened and closed 2 or 3 times for 3-5 second periods.

To thoroughly clean the screen mesh inside the filter the following steps are required.

- Close the blue ball valve next to the cistern, and close the smaller yellow handled brass ball valve just downstream from the electronic valve.
- Open the red ball valve on the end of the filter to release any residual water pressure
- Securing the top white portion of the filter with one hand, unscrew the clear filter housing with the other.
- Remove the interior screen mesh filter and thoroughly clean it with water from a hose or tap and a 1 ½ inch bottle brush.
- Clean out the clear canister with the bottle brush and a chlorine solution (1 part household bleach to 10 parts water).
- Replace the mesh filter into its housing taking care that the rubber O rings are properly seated.
- Replace the housing back into the white top portion of the filter and screw it in tightly by hand. Close the red ball valve on the filter.
- Open both the valves that were closed and observe the water flow.
- Check for drip leaks, and retighten the filter housing if required.

3.9.3 Sight Tube Water Level Indicator

The operation of the water level indicator is described in Section 3.1.1.

The condition of the sight tubing should be checked annually. It should be replaced when the vinyl becomes “cloudy” or it becomes brittle to the touch.

3.9.4 Insulated Winter Box

An exterior grade plywood box with a hinged top has been supplied to provide freeze protection for the water lines and valves just outside the tank. It is lined with solid insulation.

The longevity of the box structure will be increased by re-staining its exterior, and ensuring that organic soils do not accumulate around its base.



The box is equipped with a thermostatically controlled flood light. The thermostat has been preset (with the indicator at the black dot) to come on

when the temperature approaches freezing. The heat generated by this light, along with the heat sync function of the water mass in the cistern is sufficient to prevent freezing of the pipes and valves – even during extended power failures.

It is recommended that this bulb be replaced each year as part of the fall maintenance.

The Winter Box is also equipped with a hasp locking device. It is recommended that owners (especially those with young children) place a lock on the hasp to prevent unintentional turning of valves.

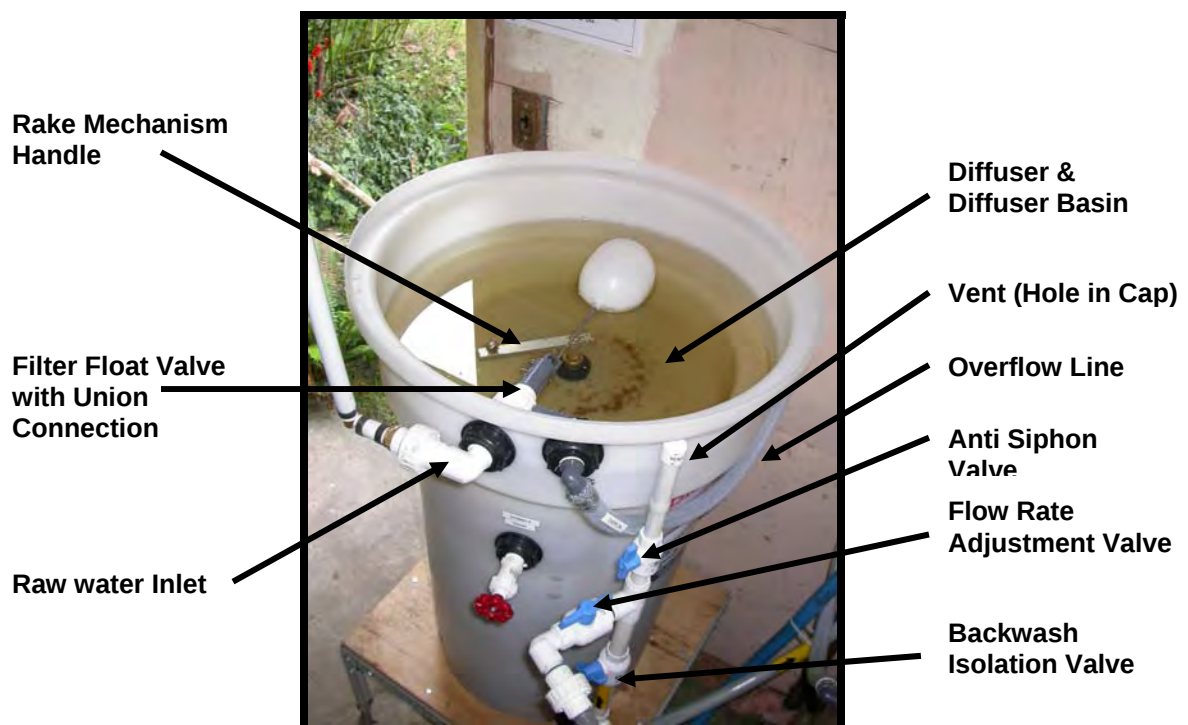
3.10 Water Purification System

The dual barrier water purification system was supplied and installed by Tiger Purification Systems Inc. from Victoria. The components are described in Section 2.9 - System Features. These components are described briefly below, and details are contained in the two manufacturer's manuals that came with the BioSand filter and the Trojan UV light.

3.10.1 BioSand Filter

Operation:

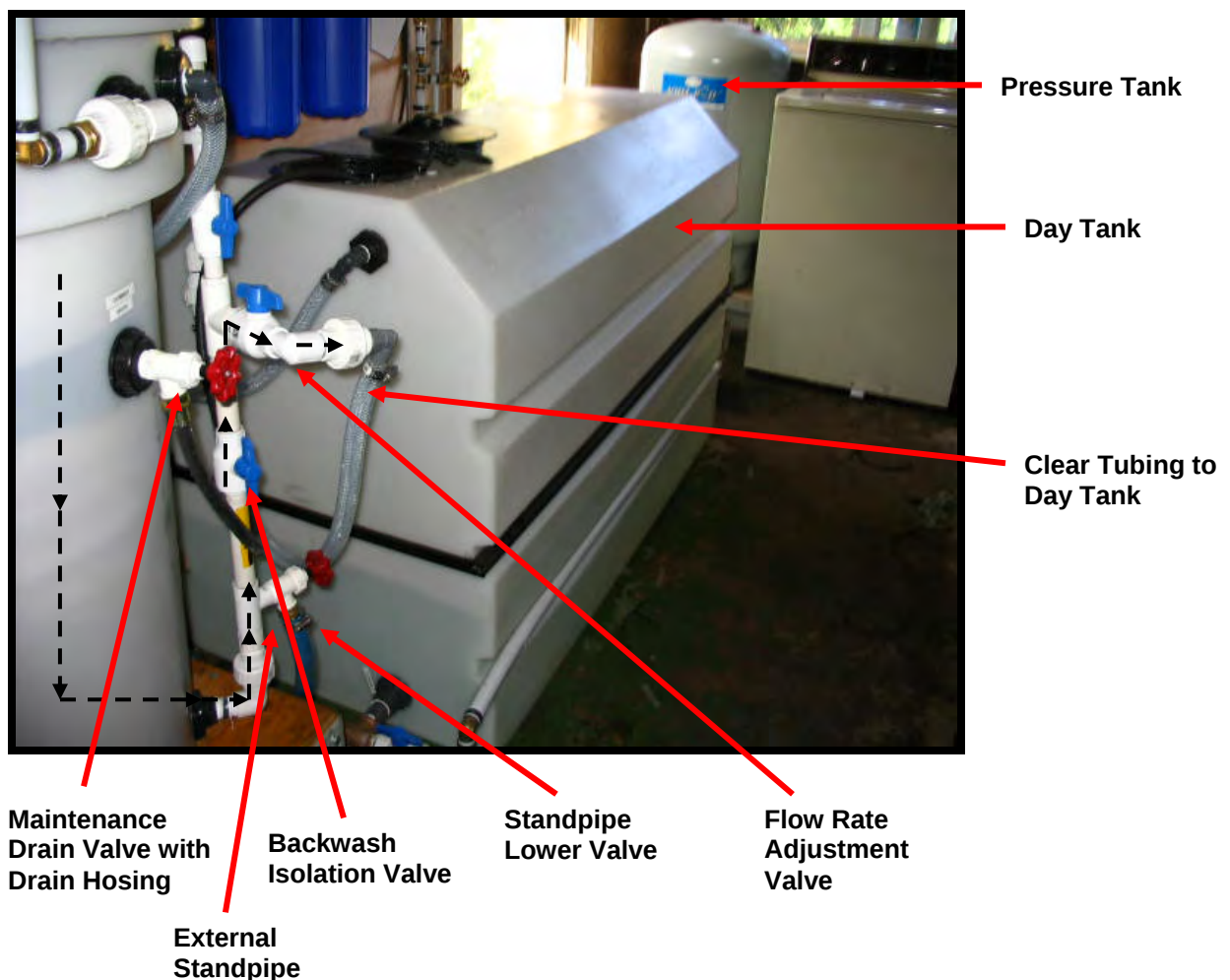
A BioSand #120 filter has been installed that can process water from the cistern at a rate of 120 litres (26 gal.) per hour. The parts are labeled on Figure 3-1 of the Davnor Manual, and some are identified in the following photographs.



The gravity flow water from the cistern enters the BioSand filter through the raw water (rainwater) inlet near the top. The filler float valve controls the rate of water entering the diffuser basin. An overflow is provided that runs to the building exterior.

The water in the diffuser basin flows down through 3 layers of quartz sand; exits out the bottom; runs up the external standpipe; and flows through clear tubing into the day tank. The flow rate adjustment valve (open in photo) controls the rate of flow out of the BioSand filter.

Note the blue hose attached to the standpipe lower valve in the photo below. This provides water from a clean water source for backfill (see item 26 on Figure 3-1 of Davnor Manual "Clean in Place (CIP) Reverse Flow", and the photo of the water filters and UV light).



Checking the Flow Rate:

When operating correctly the BioSand should be processing water at approximately 120 litres (26 imperial gal) per hour.

The following procedure is used to check this flow rate:

- With the BioSand in full operating mode, open the day tank and hold a measuring cup under the outflow.
- Measure the amount of water collected in 1 minute. One minute at a rate of 120 litres per hour is equivalent to 2 litres per minute.

Too fast a flow rate is adjusted by slightly closing (counter clockwise) the flow rate adjustment valve.

A reduced flow rate indicates that the filter needs cleaning. Do not adjust the flow rate adjustment valve until the filter has been cleaned, and the flow rate checked.

Cleaning Filter With Rake Mechanism:

This procedure floats out excess debris that can collect on the top of the biolayer of the quartz. It should be done every 2-3 weeks to prevent debris accumulation that slows the flow rate.

To clean with the rake mechanism:

- open the top of the filter;
- lift up the filler float valve, and rotate the rake mechanism handle slowly in one direction, and then the other until it rotates fairly easily and evenly;
- note: position of rake is set by adjusting shaft set screw (see Davnor manual).

Backflushing the BioSand:

Backflushing refers to running a small amount of fresh water from the bottom to the top of the quartz layers.

This process removes accumulated debris in the quartz. It should be done once per month, or more often if flow rates diminish more quickly.

The backflush procedure is carefully described in Part 9 “Filter Maintenance” of the Davnor Manual.

NOTE: It is suggested that a maintenance log be posted near the filter to keep track of when and how the filter is maintained. In this case it would be useful to also note the condition of the cistern water.

Degassing the Filter Media:

In some cases the filter media can become air locked even if the top surface appears clean. If the filter continues to run slowly after regular backflushing, it is necessary to use a degassing procedure.

This process is clearly described in Part 10 of the Davnor Manual.

NOTE: At the conclusion of each of these maintenance procedures check the flow rate and adjust the flow rate adjustment valve. If the BioSand filter continues to flow slowly after regular backwashing and degassing, call Tiger Purification Systems Inc.

Winterizing or Decommissioning the Filter:

In Alton House it will not be necessary to winterize the BioSand unless the house is being left vacant and unheated for a winter.

If required, procedures for winterizing or decommissioning the filter are explained in Parts 12 and 13 of the Davnor Manual.

3.10.2 Day Tank

The Alton House water supply system is equipped with a 1000 litre (225 imperial gallon) day tank. Water from the BioSand supplies this tank, and the pressure pump pulls water from this tank and distributes it through the filters and UV light to the house water supply piping.

This tank is white and sufficiently translucent to see the water level. The tank prevents some UV penetration, but should be shielded from any direct sunlight.

Water Level in the Day Tank:

The day tank should be 3/4 to 7/8 full.

If the water level drops below 1/3 it means that the BioSand is not producing water as fast as it is being used in the house. This is a normal occurrence at times of the day when water is being used at a fast rate, e.g. bath time or when the washing machine is being used continuously. If the water level in the tank is steadily lowering over a period of several days, check the flow rate from the BioSand (see above).

NOTE: It is also a wise precaution in this case to check overall household water use by taking several meter readings over several consecutive days, and if water use is higher than normal, check for plumbing leaks or leaky toilets or faucets.

Tank Maintenance Procedures:

The water in the day tank should be perfectly clear if the BioSand is functioning properly, and water is being used on a daily basis.

If the water becomes cloudy or there is any sign of algae growth in the tank, immediately add chlorine to the tank. 1½ teaspoons of household bleach should be sufficient. If the water remains cloudy, and there is no smell of bleach in the tank water, repeat the treatment.

Poor quality water in the day tank is an indication that the BioSand filter is not removing enough of the organics in the water from the cistern. This could be due to two things. Firstly, the filter may require cleaning (see Section 3.10.1 above), or secondly, the water in the cistern may be too turbid and laden with organics for the BioSand to operate properly. If cleaning the BioSand filter does not improve the water condition in the day tank, contact Water Tiger Purification Inc. who will specify the type of water quality tests that need to be taken of the cistern water. Based on these results it may become necessary to pre-treat the stream water before it enters the cistern (see Section 3.1.2).

Cleaning the Day Tank:

The day tank should be cleaned when sediment builds deeper than ½ inch on the bottom, or if the walls become caked with debris. This should not be necessary for 1 – 2 years.

The cleaning procedure for cleaning the day tank is the same as that described for the surge/pump tank in Section 3.7.1. Scrubbing with a solution of 1 part household bleach to 10 parts water is recommended – being careful to follow the safety warnings in Section 3.4.

3.10.3 Water Meter

After the pressure pump, the water runs through a water meter measuring in cubic meters (1 m³ equals 1000 litres or 220 imp. gal.). (see photo on next page) This is one of the most important parts of the water system.

Readings should be recorded weekly or at least every month. This record of water running through the system is used to gauge when the filters and UV light need replacement. It also becomes a guide to calculating the amount of stream water that needs to be manually added to the cistern in the summer, and to checking the system for leaks (see Section 3.1.3).

3.10.4 Particle Filters

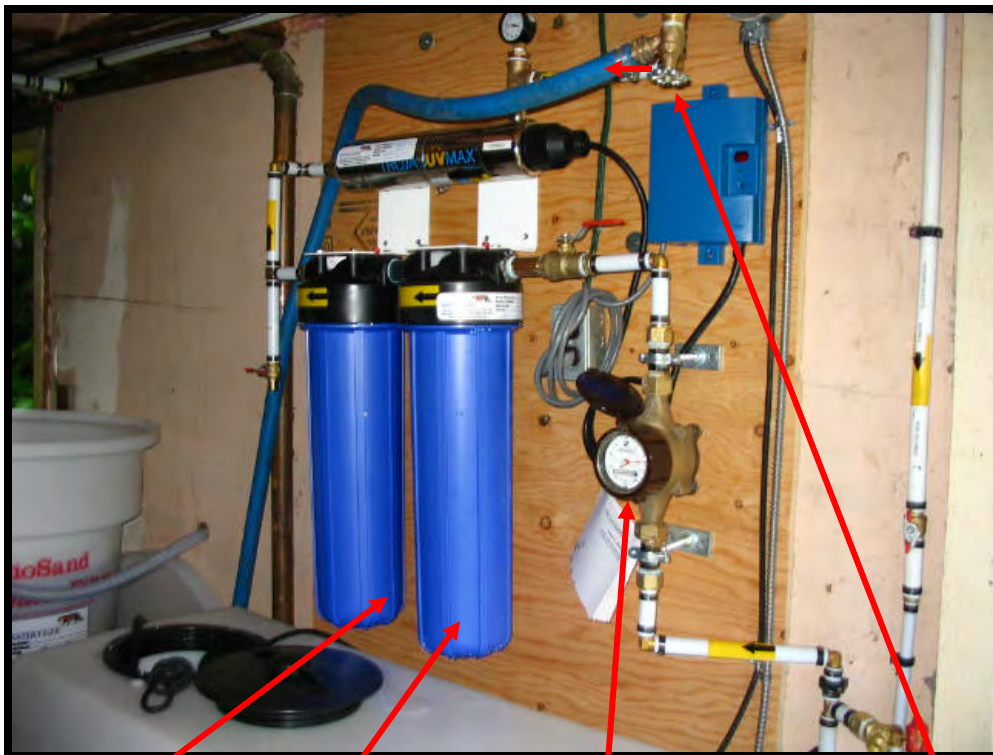
The pressurized water from the pressure pump runs through two large capacity dual gradient particle filters before it gets to the UV filter and the house

pipng. This water purification system is equipped with a 50/05 micron filter cartridge as the first filtration and a 1 micron carbon block filter cartridge.

Filter Replacement:

The filters should be checked every 6 months and replaced if dirty to their cores.

NOTE: Extremely dirty filters can restrict water flow to the point where water pressure to the house is reduced. If water pressure is lower than normal check the filter condition before calling a pump repair person.



4-1/2 x 20
1 Micron
Carbon Block Filter

4-1/2 x 20
50/05
Particle Filter

Water Meter

Clean in Place (CIP)
Reverse Flow Tap
(Blue hose to BioSand)

3.10.5 Ultra Violet Light

The last step in the water purification system is an ultra violet light to kill bacteria. A Trojan UVMAX D disinfection unit is installed. This “rural quality” UV light is designed to run consistently during power spikes and brown out conditions. It is equipped with a visual and audible alarm. It is also equipped with a self diagnosis monitoring system that provides a simple coloured light indicator of operational condition and code numbers that indicate the possible cause of any malfunction. The operation of the UV light is explained in detail in the Trojan Manual supplied with the unit. It contains a trouble shooting guide.

Maintenance Procedures:

The UV light bulb must be replaced once per year. The output of UV bulbs drops off after one year of use. A spare sleeve and bulb are on site (as of Jan. 2006).

The bulb replacement procedure and other service checks are described in the Trojan Manual supplied with the unit.

3.10.6 Special Procedures when Leaving for Holidays

If the house is going to be vacant for a relatively short period (1-3 weeks) the BioSand, Filters and UV light can be left in full operational mode.

If the house will be vacated for an extended period, the entire system should be shut down and restarted. This includes:

- winterizing the BioSand;
- emptying the day tank ;
- removing and storing the filters; and
- turning off the Ultra Violet light.

3.10.7 Water Quality Testing

It is recommended that the tap water be tested every 12 months.

The test should be for coliform bacteria (fecal and background) at the kitchen tap.

The test must be done by a BC accredited laboratory.

3.10.8 Summary Maintenance Checklist for Water Purification System

Every 2 weeks:

- Undertake the raking procedure on the BioSand filter

Every month to 6 weeks:

- Backflush and rake the BioSand

Every 6 months:

- degass the BioSand if flow rate slows
- check and possibly replace the particle filters

Every Year:

- Replace the UV bulb

Every 2 years:

- Clean the Day Tank

3.11 Checklist for Extreme Winter Freezing Conditions

Ensure dripper plugs on debris pigtails are functioning

It is especially important to check the dripping function of these debris pigtails in the winter during freezing conditions. If the end plug is not dripping, the water build up in the pipe can freeze and damage the piping.

Open dripper plug on Gravity Mesh filters

The four gravity mesh filters are equipped with a small dripper or cleaning plug on the bottom of their housing. It is recommended that these plugs be loosened during freezing weather to allow a slow drip. This prevents freezing of the water trapped in the housing which can damage the stainless steel mesh screens.

Remove the pump in the Surge/Pump Tank

In extreme and extended freezing conditions check the surge/pump to ensure that the residual water in the tank is not freezing. If it has not frozen, manually pump the tank empty (see Section 3.7.2). If it is starting to freeze, remove the pump until thaw conditions return. This prevents damage that can result from water freezing inside the pump.

3.12 Maintenance When House is Vacant

If the house is going to be vacant for over a month it is recommended that someone be assigned to maintain the system as outlined above, or that the system be shut down.

To shut down the rainwater and stream water systems the following procedure is recommended.

- Close all the valves on the stream water supply lines
- Loosen the two debris pigtail plugs
- Remove the plug ends from the first flush diverters.
- Remove the mesh screens in the gravity filters and store inside.
- Remove the mesh screen in the Rusco filter on the stream water in-line, and store it inside
- Empty and clean the surge/pump tank.
- Remove the transfer pump and store it inside.

The water purification system will also require special attention if it is to be shut down for extended periods (see Section 3.10.6 and the separate Davnor “Installation, Operations & Maintenance Manual” supplied with the BioSand filter).

3.13 Longer Term Maintenance Considerations

Replacement of Roof Zinc Strips

The zinc strips should be replaced or a second row added if moss growth increases.

Future Roof Replacement

When it is decided to replace the roof, an enameled steel roof surface should be considered because of the improved water quality that would result. A rainwater specialist should be consulted at that time because safety features such as eye bolts at the peak and snow rails should be considered as part of the installation. The system should then be monitored, and if initial water quality has improved, it may be possible to reduce the drip rate of the first flush diverter system.

Future Gutter Guard

Debris in the gutters should be monitored over the fall and spring of 2006 to help determine whether it is necessary to add gutter guard to reduce the frequency of gutter cleaning. It is most likely that gutter guard would be beneficial and cost effective on the east (water facing) side of the building

because cleaning of this gutter is the most difficult and dangerous. The decision to add gutter guard, and the type to add, will depend on the difficulty (and cost) of required cleaning. An easily removable type would be required because of the difficulty in accessing them. The least expensive type of this gutter guard costs approx. \$4 per linear foot installed. There is also a stainless steel mesh version that virtually eliminates the need to remove the guard and clean under it, but it costs almost \$15 per linear foot installed.

Painting of Exposed Catchment Piping

The longevity of the catchment piping on the south wall be increased by repainting the pipe when the original paint starts to fade or crack.

Replacement of Screen Mesh Filters

With regular cleaning the screen mesh filters inside the Banjo and the Rusco filters should last for at least 5 years.

Replacement filters are available through the Rainwater Connection and some specialty plumbing and water treatment outlets.

Surge/Pump Tank

The surge pump tank should have a life of over 15 years. Its longevity can be increased by ensuring that it is not backfilled any deeper than installed, and that any sections that are exposed to the sun are painted (plastic paint supplied) or covered with a wood box or other covering that prevents exposure to the U V from sunlight.

Replacement of Vinyl Sight Tube

The ½ inch inside diameter vinyl sight tube may need replacement within 2-5 years.

This type of tubing is available at most hosing specialist stores, and replacement only requires a flat head screwdriver to release the hose clamp at the bottom.

Alternatively, a replacement kit (including new float balls) is available through the Rainwater Connection.

Pretreatment of Stream Water

It is understood that the existing stream water catchment cistern and the intake pipe will be cleaned and modified to reduce the amount of sediment contained in the stream water.

The BioSand filter is not designed to deal with the concentrations of organics that were contained in the stream water during the summer of 2005. If the

stream water quality is not improved it may be necessary to pre treat the stream water before it enters the cistern.

A water sample should be taken when the stream water intake system is improved. Based on this sample, it will be possible to determine if pretreatment is required, and if so, what type would be most effective.

Future Connections to a Household Generator Backup System

If a generator or solar backup electrical system is being considered for the house three circuits that run the water supply system should be added to the alternate energy circuit box. These are the circuits that power:

- the transfer pump in the surge/pump tank;
- the house pressure pump, and
- the receptacle running the UV light

4.0 SAFETY GUIDELINES

Roof and Gutter Cleaning

The roof is too steep for a person to safely walk on it for purposes of hand or machine cleaning. A safety harness and rope attached to the chimney should be used at all times.

The gutters on the east side are a full two stories above grade. A tall ladder can be used, but given the height and poor ladder footage on the sloped backyard, it is recommended to service them from the roof using a safety harness.

Pipe Cleaning Chemicals for Pipe and Surge/Pump Tank Cleaning

Use either hydrogen peroxide or chlorine with extreme care.

With either cleaner avoid contact with eyes or skin. In case of contact, flush promptly with abundant water.

- Harmful if swallowed.
- Read and follow the manufactures instructions on the container.
- Both cleaners can mark clothing.

NEVER use hydrogen peroxide if chlorine is being used anywhere in the catchment or storage system. A dangerous chemical reaction can occur.

DO NOT use any other type of household cleaner which may contain soap or other chemicals which could affect the quality of the collected water, or react with chlorine.

Surge Pump Tank

Keep the inspection hatch closed at all times to avoid the possibility of small rodents entering and drowning in the tank.

Electrical Components and Float Switches

Unplug any pump or other system component before touching or servicing it.

DO NOT attempt to service the float switches. Contact the Rainwater Connection or an electrician.

Cistern

This tank qualifies as a confined space. The air inside may not contain sufficient oxygen to maintain consciousness. Never enter the cistern without a respirator, and follow all of the other current regulations of the WCB.

This tank is often filled with sufficient water for a person to drown in.

Keep the access hatch locked except when servicing, and never leave an unlocked tank unattended.

As a further precaution, never leave a ladder in place which could provide access to the tank roof.

5.0 TROUBLE SHOOTING

The Debris Pigtail Piping seems cracked and is leaking.

- The pipe has probably been subjected to freezing of built up water, and will need to be replaced.
- Call the Rainwater Connection or your local plumber for repairs.

Water is flowing out of the top of the standpipe just under the debris traps

- This is most likely to occur during periods of heavy rain. The water is backing up the catchment pipe because the gravity screen mesh filters have become clogged with debris.

Solution:

- Remove and clean the mesh screens.

The transfer pump has stopped and water is overflowing from the surge/pump tank overflow pipe

- Is the power on? The pump won't run and the surge/pump tank will overflow during a power outage or if the circuit breaker has tripped. Check the circuit breaker. If the breaker won't reset call the electrician (Dave Abley at Salt Spring Island Electric)
- Is the main cistern full? A float switch in the cistern automatically disables this circuit and thus turns the pump off when the cistern is full (see Section 3.7.2). The pump will restart when the water level in the cistern has dropped sufficiently for the float switch to reactivate the circuit.
- If the power is on and the cistern is not full, check to see if the pump is malfunctioning.
- Run an extension cord from some other electrical outlet and plug the pump into it. If it does not run, even with the float switch held up, the pump needs servicing or replacement (Call Water Tiger Purification Systems Inc.).

When the transfer pump stops pumping some water seems to flow back through the pump into the surge/pump tank

- This is to be expected. There is no backflow preventer in the rainwater up line to the cistern, so water in the line will drain back between pump ups. This prevents water collecting in the line and becoming stagnant or freezing.

Stream water is not flowing into the cistern

- Are the valves that control this flow open? (see Section 3.1.2)

If yes:

Is the water level in the cistern higher than 46 inches? The stream water float switch in the cistern automatically turns off the stream water flow when the cistern is approx. 60% full (see Section 3.1.2)

- Is the screen mesh filter inside the winter box clogged? (see Section 3.9.2)

If no:

Owners Manual: Rainwater Harvesting and Water Supply System

- Is there sufficient water in the stream water supply tank located near the stream to supply water?

If yes:

The stream water float switch in the cistern may be malfunctioning.

- Manually lift and release the float switch to check if the internal slide mechanism has stuck.
- If stream water does not start to flow, call the electrician (Dave Abley at Salt Spring Island Electric).

The cistern is overflowing.

- The system is designed to prevent the cistern from overflowing because of a concern with the drainage around the cistern.
 1. Open the cistern hatch, and determine which water supply pipe is still supplying water.
 2. If stream water is flowing into the cistern the float switch and/or electronic valve is malfunctioning.
 3. manually lift and release the float switch to check if the internal slide mechanism has stuck
 4. open and shut the manual override switch to reset the electronic valve.
 5. If the water flow does not stop, close off the stream water supply valve and call Water Tiger Purification Systems Inc. for service
 6. If rainwater is flowing into the cistern, the float switch that disables the electric circuit powering the transfer pump in the surge/pump tank is malfunctioning.
 7. Manually lift and release the rainwater float switch in the cistern to check if the internal slide mechanism has stuck.
 8. If the water flow does not stop (i.e. the transfer pump is still operating) turn off this electrical circuit at the breaker and call the electrician (Dave Abley at Salt Spring Island Electric)

The power has come back on. What needs to be checked?

- All aspects of the house pressure system and the water catchment system should restart and run normally.

Trouble Shooting for the BioSand Filter

The Davnor Manual that was supplied with the BioSand filter has a full Trouble Shooting Guide (part 14) that deals with concerns such as low flow rate, water not entering the filter, and storage tank overfilling. Further questions can be directed to Water Tiger Purification Systems Inc.

Trouble Shooting for the Ultra Violet Light

A manufacturer owners guide is supplied with the Trojan UVMAX D Ultra Violet light. It contains a description of features, maintenance schedules and troubleshooting. Further questions can be directed to Water Tiger Purification Systems Inc.

APPENDICES

Appendix A Water Balance Table and Water Requirements: May 25, 2005

Alton Water Balance Table May25 05.xls
Projected Monthly Water Storage

Location: Salt Spring Island
 Property: Alton House Demonstration Project
 Scenario: 5980 Cistern / 4 person Hhhd.

Collection Area #1 (sqft): 2100
 Collection Area #2 (sqft): 0
 Collection Area #3 (sqft): 0
 TOTAL Collection Area: 2100

Max Storage Cap (gal): 5980
 Volume Units: gal
Choose one of gal or litre

Assumed Rainfall Level used in Calculation: Avg
Enter 10% : 20% : 30% : 50% Max: Avg Min

Month	Indoor Usage gal/mon	Outdoor Usage gal/mon	Assumed Rainfall inches	Assumed Collection Efficiency	Rainfall Collected gal/mon	Alternate Supply gal/mon	End of month Storage gal/mon
Start							0
November	4050	0	6.6	80%	5744	0	1694
December	4050	0	5.9	80%	5139	0	2784
January	4050	0	6.0	80%	5235	0	3969
February	4050	0	4.2	80%	3689	2000	5608
March	4050	0	3.4	70%	2621	1800	5979
April	4050	0	2.3	45%	1112	2900	5941
May	4050	0	1.7	70%	1307	2800	5980
June	4050	500	1.5	65%	1058	3500	5980
July	4050	500	1.0	65%	679	2200	4309
August	4050	500	1.2	65%	842	2200	2801
September	4050	500	1.3	65%	894	2400	1546
October	4050	0	3.5	70%	2647	1500	1643
TOTAL	48,600	2,000	38.4		30,968	21,300	1,668 Surplus Supply

3/25/2005 The Rainwater Connection page 1 of 1

Owners Manual: Rainwater Harvesting and Water Supply System

The following summarizes the total estimated amount of water that will be required by the Ruby Alton House over a typical year. In addition it estimates how much of this total will be supplied by rainwater each month, and how much stream water will be required to supplement the rainwater supply.

This analysis updates the last water storage calculation that was done in March 2005, and reflects the larger cistern size.

The attached Projected Monthly Water Storage spreadsheet entitled "Ruby Alton House Water Balance Table May 25-05" describes the amount of water that would be in a 5,980 imperial gallon cistern at the end of each month (right hand column). It is based on the following.

Rainfall Amounts

Average precipitation statistics for St Mary's Lake weather station are used. The attached Historical Rainfall -Variation page summarizes 22 years of rainfall statistics starting in 1981. The average annual precipitation total is 38.4 inches (975mm).

Rainfall for the Ruby Alton House location is estimated to be approx. 15% higher than St Mary's Lake which means that the rainwater amounts used in this table should be typical for a year that is 15% dryer than normal.

Catchment Area

The roof catchment comes entirely from the main house, and the roof catchment area is 2,100 sq. ft. (195m²).

Catchment Efficiency

The asphalt shingle roof has a lower water catchment efficiency than other smoother surfaces such as steel or glazed tile. This is due to higher evaporation rates for light or intermittent summer rainfall events as well as the need to reject a larger quantity of the first flush of each rain. This system is designed to reject the first 0.3 inch (0.75mm) of rainfall per 24-hour period per square foot (.093m²) of roof catchment area.

It is assumed however that the catchment system is otherwise quite efficient and collects 80% of winter rains, 70% of shoulder season rain, and 65% of summer rain with a short shut-down period and cleaning during the pollen season in April.

Indoor Water Use

Indoor water use reflects a conservator attitude, and assumes the use of low water use fixtures such as low flush toilets, and a water efficient dishwasher and clothes washing machine. A standard of 40 US gal/person/day OR 151.5 litres OR 33.3 imperial gal/person/day (G/P/D)

Use assumes full time occupancy by a family of 4 persons. Daily use would be 606 litres or 133 imperial gallons per day.

Monthly use is assumed to be equal in each month at 18,425 litres or 4,050 imperial gallons.

Outdoor Water Use

A conservative assumption of approximately 500 gallons per month of outdoor water use is added during the peak outdoor watering months – June thru Sept. This assumes that most of the garden watering needs are met by the separate garden water rainwater system. It is further assumed that a minimum of 1,500 imperial gallon will be retained in the cistern at all times to provide emergency water for fire or earthquake.

Conclusions

Using the above assumptions, rainwater catchment over a 12 month period will total almost 31,000 imperial gallons (141,000 litres). This amounts to 61% of the total annual household water demand. The house would run entirely on the rainwater from November through January each year, but will require a total of 21,300 gallons of stream water to supplement the rainwater supply. The provision of this size of cistern reduces the summer stream water demand to 2,200-2,400 gallons per month during the driest summer months.

The summer draw on the stream water could be reduced by approximately 500 gallons per month if the 1,500 gallon emergency water supply requirement was used to supply the house.

APPENDIX B

Maintenance Tools and Replacement Parts Provided

This Appendix to the Owners Manual for the Alton House rainwater harvesting and water supply system lists the equipment required for the ongoing maintenance of the system, and suggests the type of spare parts that the owner may wish to keep on hand.

Standard Maintenance Kit for Rainwater System

- 2 keys for the cistern padlock
- spare 30 mesh screen for Banjo filters
- 4" First Flush Diverter plug with 3/32" hole
- 3" First Flush Diverter plug with 3/32" hole
- small 7" adjustable wrench
- 3" poly brush attached to 25 foot long plumbers snake
- 3" toilet cleaning brush
- grout and tile brush
- 1 ½ " bottle cleaning brush
- 1 can of green plastic spray paint for surge/pump tank
- 2 cans plastic spray paint primer
- partial can of brown paint used for catchment pipes
- partial can of Bullseye 1 2 3 primer paint for PVC piping
- small container of chlorine tablets
- chlorine dispenser on rope tether
- 4 liter size measuring cup

Other Equipment Required by Owner or Cleaning Contractor

- 20 foot extension ladder for access to west roof
- shoulders for ladder to keep ladder from resting on the gutters
- climbing grade safety rope and full chest harness for working on roof
- lightweight leaf or air blower (gasoline powered – cordless)
- Spray bottle with household bleach with no additives or Oxy Jan 7% solution of Hydrogen Peroxide (preferred)
- cleaning bucket and rags
- light bulbs for winter box

APPENDIX C

Monthly Maintenance Checklist

This appendix contains the 2 page Monthly Maintenance Checklist for the Alton House Water Supply System. A print ready copy is also included with the manual to facilitate the production of multiple paper copies for record keeping.

The Rainwater Connection encourages the owner to fax copies of these completed forms to us every 3 months during the first two years of system operation. The information will be used to help monitor system operation to guide the design of future systems. The Rainwater Connection will contact the owner if the data indicates changes that should be made to the system or the maintenance procedures.

It must be noted that some of these maintenance procedures can be a safety hazard. A list of safety warnings is listed below, and the tasks where a hazard exists is marked with a ▲ in the table.

SAFETY HAZARDS

Roof and Gutter Cleaning

The roof is too steep for a person to safely walk on it for purposes of hand or machine cleaning. A *safety harness and rope attached* to the chimney should be used at all times.

The gutters on the east side are a full two stories above grade. A tall ladder can be used, but given the height and poor ladder footage on the sloped backyard, it is recommended to service them from the *roof using a safety harness*.

Pipe Cleaning Chemicals for pipe and surge/pump tank cleaning

Use either hydrogen peroxide or chlorine with extreme care. With either cleaner *avoid contact with eyes or skin*. In case of contact, flush promptly with abundant water. Read and follow the manufactures instructions on the container.

Harmful if swallowed.

Both cleaners can mark clothing.

NEVER use hydrogen peroxide if chlorine is being used anywhere in the catchment or storage system. A dangerous chemical reaction can occur. *DO NOT* use any other type of household cleaner which may contain soap or other chemicals which could affect the quality of the collected water, or react with chlorine.

Surge Pump Tank

Keep the *inspection hatch closed at all times* to avoid the possibility of small rodents entering and drowning in the tank.

Electrical Components and Float Switches

Unplug any pump or other system component before touching or servicing it.

DO NOT attempt to service the float switches. Contact the Rainwater Connection or an electrician.

Cistern

This tank qualifies as a confined space. The air inside may not contain sufficient oxygen to maintain consciousness. *NEVER* enter the cistern without a respirator, and follow all of the other current regulations of the WCB.

This tank is often filled with sufficient water for a person to drown in.

Keep the *access hatch locked* except when servicing, and never leave an unlocked tank unattended.

As a further precaution, never leave a ladder in place which could provide access to the tank roof.

MONTHLY MAINTENANCE CHECKLIST

Alton House, Water Supply System

Date: _____

Inspector: _____

Use these forms for recording monthly cleaning and maintenance inspections.

ITEM	CONDITION/ACTION TAKEN
Blow off Roof ▲ Inspect monthly, and clean with air blower if required during the spring, summer and fall. Special attention in Sept. and Oct. [Refer to Section 3.2.2]	
Clean Gutters ▲ Inspect monthly and blow or hand clean as required. With gutter guard clean the top monthly, and inspect and clean the gutters underneath every 2 or 3 months. [refer to Section 3.2.3]	
Clean Debris Traps Monthly or as needed just before rainfalls. Check and clean leaf catcher and debris pigtail under it Inspect all-in-one debris pail. Clean debris filter cloths and replace filter when saturated with needles. Remove and clean lower chamber if required. Open and clean debris pigtail plugs Every 2-3 months remove filter in the 4" high capacity debris filter, and clean if required. [refer to Section 3.3]	

ITEM	CONDITION/ACTION TAKEN
Check Catchment Piping on South Wall ▲ Inspect in July and August If collected debris smells, rinse and clean to reduce warmth fostered bacterial growth [open the appropriate drains and be careful with the cleaning agents – refer to Section 3.4]	
Inspect and Clean 2 Inch Gravity Mesh Filters At start up inspect bi-monthly to determine rate of filling After two months inspect monthly and clean if required [refer to Section 3.5]	
First Flush Diverter Pipe Monthly spring through fall. Less frequently in winter. Check exit valve operation – i.e. the drip rate during or just after a rain. Clean the threads and/or the exit hole if required. [refer to Section 3.6]	
Surge/Pump Tank ▲ Inspect monthly and check condition of residual water in tank If water is badly coloured; has a smell, or if sediment is over ½ inch in depth, pump the tank dry and clean it. Add 2 chlorine tablets to floating dispenser. Ensure inspection hatch is securely closed [refer to Section 3.7]	
Check Steam Water In-line Rusco Filter Visually inspect monthly Flush out, or remove and clean mesh screen if required. [refer to Section 3.9.2]	

ITEM	CONDITION/ACTION TAKEN
House Supply Meter Reading Record accumulated water use number	
SPECIAL ITEMS DURING EXTREME WINTER FREEZING CONDITIONS open and drain first flush diverters empty dripper plugs on debris pigtails open drip plug on gravity mesh filters pump surge/pump tank empty and/or remove pump check light bulb in winter box [refer to Section 3.11]	

APPENDIX D

Spring & Fall Maintenance Checklist

This appendix contains the 3 page Spring & Fall Maintenance Checklist for the Alton House Water Supply System.

A print ready copy is also included with the manual to facilitate the production of multiple paper copies for record keeping.

The Rainwater Connection encourages the owner to fax copies of these completed forms to us every 3 months during the first two years of system operation. The information will be used to help monitor system operation to guide the design of future systems.

The Rainwater Connection will contact the owner if the data indicates changes that should be made to the system or the maintenance procedures.

It must be noted that some of these maintenance procedures can be a safety hazard. A list of safety warnings is listed below, and the tasks where a hazard exists is marked with a ▲ in the table.

SAFETY HAZARDS

Roof and Gutter Cleaning

The roof is too steep for a person to safely walk on it for purposes of hand or machine cleaning. A *safety harness and rope attached* to the chimney should be used at all times.

The gutters on the east side are a full two stories above grade. A tall ladder can be used, but given the height and poor ladder footage on the sloped backyard, it is recommended to service them from the *roof using a safety harness*.

Pipe Cleaning Chemicals for pipe and surge/pump tank cleaning

Use either hydrogen peroxide or chlorine with extreme care.

With either cleaner *avoid contact with eyes or skin*. In case of contact, flush promptly with abundant water.

Harmful if swallowed.

Read and follow the manufactures instructions on the container.

Both cleaners can mark clothing.

NEVER use hydrogen peroxide if chlorine is being used anywhere in the catchment or storage system. A dangerous chemical reaction can occur.

DO NOT use any other type of household cleaner which may contain soap or other chemicals which could affect the quality of the collected water, or react with chlorine.

Surge Pump Tank

Keep the *inspection hatch closed at all times* to avoid the possibility of small rodents entering and drowning in the tank.

Electrical Components and Float Switches

Unplug any pump or other system component before touching or servicing it.

DO NOT attempt to service the float switches. Contact the Rainwater Connection or an electrician.

Cistern

This tank qualifies as a confined space. The air inside may not contain sufficient oxygen to maintain consciousness. *NEVER* enter the cistern without a respirator, and follow all of the other current regulations of the WCB.

This tank is often filled with sufficient water for a person to drown in.

Keep the *access hatch locked* except when servicing, and never leave an unlocked tank unattended.

As a further precaution, never leave a ladder in place which could provide access to the tank roof.

CAUTION

Before cleaning the roof or gutters with water, open and remove:

1. the debris pigtail plugs,
2. the plastic filter inside the 4" high capacity filter
3. the screen inside the Banjo filters, and
4. the first flush diverter end plugs.

This ensures that none of this contaminated water reaches the surge/pump tank.

DO NOT use hydrogen peroxide or any other cleaning agent on the mesh screen or filter housing. These can reduce the longevity of the stainless steel in the mesh screens.

SPRING & FALL SERVICING CHECKLIST

Date: _____

Inspector: _____

Use these forms for recording spring (April or May) and fall (Oct. or Nov.) maintenance inspections and cleaning.

ITEM	CONDITION/ACTION TAKEN
Clean Roof ▲ After pollen season in late April or May and again in late October or November after the leaves and fir needles have fallen. De-moss by hand, blow, and rinse with water. [refer to procedures in Section 3.2.2] Assess whether new zinc strips need to be added. [refer to Section 3.13]	
Clean Gutters ▲ Thorough cleaning in spring after pollen season and in the fall Inspect and record amount and type of debris Clean by brush, pressure washer, and by hand if required rinse with hydrogen peroxide or bleach If Gutter Guard is installed also inspect gutters in July and Sept, and clean if required. [refer to procedures and Safety Warning in Section 3.2.3]	

ITEM	CONDITION/ACTION TAKEN
Clean Leaf/Debris Traps Spring and Fall when the catchment piping is being cleaned. Inspect and record debris amounts and types in each type of debris trap Open and clean debris pigtail plugs Clean leaf catcher and debris pigtail under it Clean all-in-one debris pail. Clean debris filter cloths and replace filter if saturated with needles. Remove and clean lower chamber. Inspect and clean standpipe below filter. Remove filter in the 4" high capacity debris filter, and clean. [refer to Section 3.3]	
Clean Catchment Piping ▲ Clean in spring. Inspect and clean in fall if pipes are dirty or smelly Record amount and type of sediment in pipes Open the appropriate drains and remove filters Use the brush on the plumbers snake Follow the safety warnings. [refer to Section 3.4]	
Inspect and Clean 2 Inch Gravity Mesh Filters Open and inspect the stainless steel mesh screen and record sediment amount and type Clean mesh screen, housing and adjacent piping as described in Section 3.5 Inspect mesh for small perforations or tears and replace if necessary	

ITEM	CONDITION/ACTION TAKEN
Clean First Flush Diverter Pipes ▲ Empty any trapped water Record condition of pipes as observed from lower end Clean the threads and/or the exit hole Partially fill with water and check the drip rate (54 and 28 ml per minute) If pipe is extremely dirty, clean it using Catchment Pipe cleaning procedure in Section 3.4. [refer to Section 3.6 and 3.4]	
Service Surge Tank ▲ Full cleaning in spring, and fall if required. Read and follow the safety warnings in Section 3.7. Check and record smell, colour & sediment depth of residual water Check operation of float switch by lifting it up and waiting for the pump to start Pump the tank dry and clean it Check pump bottom water entry grill, and clean if required. Add 2 chlorine tablets to the floating chlorine dispenser. Check filter cloth in the vents of the inspection hatch, and ensure that it is securely closed. In fall check screening on end of surge/pump tank overflow pipe, and remove and clean if required [refer to Section 3.7]	

ITEM	CONDITION/ACTION TAKEN
Service Cistern and Fittings Once per year in the fall Brush or blow accumulated debris off the cistern roof Check functioning of padlock on roof hatch, and lubricate if necessary Inspect integrity of screening, and repair damaged portions if required. From the inspection hatch visually check the sediment level in the tank. Record its colour and texture. If there are significant deposits use a measuring stick with a padded end to measure depth. Inspect screening on end of overflow pipe, and clean if required. Check drain rock circle around tank and winter box, clean up debris if required Replace light bulb in winter box [for all of the above refer to Section 3.9] check condition of vinyl sight tube (water level indicator), and replace if necessary [Section 3.13] Once per year in the spring: Assess need to re-stain the winter box exterior Check valve function of cistern <i>valves by briefly opening and closing them.</i>	
House Supply Meter Reading Record accumulated water use number	
Compare Cistern and Metered Water Use Once per year in the fall compare cistern volume to metered usage to check for pipe or cistern leakage. [refer to Section 3.1.3]	