PELE'S CHALLENGE :
HAWAI'I VOLCANIC POLLUTION EFFECT ON POTABLE RAINWATER CATCHMENT SYSTEMS STUDY

Final
Revised : 5-15-26

SHEET 1

Uncle Tilo's Clean Water LLC was founded in 2017 to meet a critical need in Hawai'i: empowering households that rely on rainwater catchment systems with education, trusted solutions, and professional support. Our mission has always centered on protecting health through knowledge, accountability, and practical system care.

Today, UTCW serves the community through our online store,

UTCW : ARCSA'S LOCAL CLEAN WATER HEROES

SHEET 2

Precautionary Measures for Residential Rainwater Catchment Users During Volcanic Activity

Residential rainwater catchments are not regulated as public drinking water supplies and there is no government agency oversight of these systems in Hawaii. Homeowners and users are responsible for their maintenance, proper usage and for monitoring their own water quality.

Activity at Kilauea volcano has raised concerns about the possible impacts to rainwater catchment systems on the island of Hawaii. As ash, laze, and Pele's Hair have been found to contain various metals and are hazardous to ingest, catchment users should avoid accumulating it in their water tanks. The Department of Health (DOH), Safe Drinking Water Branch (SDWB) has summarized the various recommendations made thus far, to help protect the users of these systems located downwind of volcanic activity.

DURING VOLCANIC ACTIVITY

- Temporarily disconnect the gutters feeding into the tank.
- Do not reconnect the system until the volcanic hazards (i.e. ash, laze, Pele's hair in the air) have passed and the ash and debris are washed off the roof, out of the gutters and the tank.
- Place a free-standing or self-supporting non-porous canopy to cover mesh tank covers so that less debris will get in.
- Obtain water from the County of Hawaii Department of Water Supply's emergency spigots.

In addition to the above special precautions, remember to routinely perform the three (3) P's for residential rainwater catchment systems:

PREVENT CONTAMINATION OF YOUR WATER THROUGH FREQUENT AND PROPER MAINTENANCE.

- Remove any dirt, debris, or other litter from your roof, gutters, or inside your water tank.
- Trim or remove any plants or trees that overhang your home.
- Make sure that your water tank cover and vent screens are secure and not broken or cracked.
- Frequently check your sediment filters, clean the filter housing and replace dirty filters in accordance with manufacturer's specifications.
- Use nonmetal plumbing materials and fixtures that are ANSI/NSF Standard 61 certified to reduce the levels of metals that can be leached out by acidic catchment water.
- Use first flush diverters to help reduce the amount of debris entering the tank.

PROTECT YOURSELF FROM HARMFUL CONTAMINANTS BY TREATING YOUR WATER.

- Carefully read and follow the water treatment device manufacturer's instructions or operating manual for correct installation, operation, and maintenance.
- Disinfection (Chlorine, Ultraviolet, or both) is strongly recommended for catchment water supplies. A suggested starting point would be to add 2-1/2 tablespoons of unscented 5% household bleach per 1,000 gallons of water in the tank, mix thoroughly, measure free chlorine residual, and repeat the dosing/mixing/measuring process until there is about 0.5 milligrams per liter of free chlorine in the tank. Perform as often as needed to maintain that level.
- If you have an Ultraviolet (UV) disinfection system, regularly wipe down the light bulb to remove any mineral buildup. Check the light bulb to make sure that it is working properly and replace bulbs as recommended by the manufacturer.
- Wherever possible do not add anything to your water supply that is not food grade quality or certified in accordance with ANSI/NSF Standard 60 for drinking water applications.

PROVE THE EFFECTIVENESS OF YOUR PREVENTION AND PROTECTION EFFORTS THROUGH PERIODIC TESTING.

- Testing is the only way to verify if your catchment treatment and maintenance is working.
- Bacteria test kits for detecting fecal contamination are available from the University of Hawaii, College of Tropical Agriculture and Human Resources (CTAHR) Hilo extension office - http://www.ctahr.hawaii.edu/hawaiirain/test.html.
- Chlorine test strips are simple to use and also readily available through CTAHR and others. This helps those who regularly disinfect with unscented chlorine bleach or calcium hypochlorite.
- pH test strips are also simple to use and also readily available through CTAHR and others. This helps those who try to adjust the pH and alkalinity of acidic rain by adding baking soda.
- **CAUTION:** Test kits do not replace testing by a laboratory certified for testing specific drinking water contaminants. Kits for lead and other contaminants can be found in local hardware stores and can be used as a screening tool to determine if a larger problem may exist requiring more accurate testing by a certified lab. However, kits are not available for all contaminants and they may not be sensitive, accurate, or reliable enough to compare their results against known drinking water standards. Certified labs may be found in the phone book or on the DOH-SDWB website at http://health.hawaii.gov/sdwb/.
- The DOH-SDWB currently subsidizes the testing for lead and copper in individual homes served by rainwater catchment systems. Owners or users of rainwater

Please note the Hawaii State Department of Health advises people to not drink catchment water due to the risk of infectious diseases such as Rat Lung Worm and leptospirosis. However, showering, washing dishes and laundry uses are safe.

UTCW RECOMMENDATIONS

1. Enhanced Filtration Systems
Mesh or Filter Screens: Use fine mesh filters (like a **200-micron or smaller**) installed at the first flush diverter, as well as Uncle Tilo's Basic Bag at the point of entry into the tank (500-1000 microns). These can capture the fine volcanic fibers before they enter the tank.
Comments : see Options 3 and 4 below

Activated Carbon Filters: These can help further reduce the presence of micro-particles, especially once the water is in the storage tank. They can also help remove any other contaminants from the water. We recommend a **5 micron Activated Carbon Block**.
Sediment Filters: Installing sediment filters, which filter out particulate matter, is essential for removing particles like Pele's hair. The filtration should ideally go down to very fine particulates. We recommend a **20 Micron Poly**. Not paper or string.

Comments : we agree with these filter selections and recommend a 0.50 Micron point of use filter.

2. Improved First Flush Systems
More Effective First Flush Diverters: While the first flush system alone may not be sufficient, consider using more robust systems that **can handle greater volumes of water to divert and collect a larger amount of debris.** Some systems are designed to capture heavier particles first and then gradually divert the rest of the rainwater.

Comments : See Option 1 below

Increased Diversion: Adding a secondary first flush system or improving the existing system's capacity could help prevent finer particles from entering the storage tanks. Consider designing the system to handle multiple flush stages, with each stage targeting different particle sizes.

Comments: see Option 2 below:

3. Regular Maintenance
Rooftop Cleaning: Regularly cleaning your rooftop, especially after volcanic activity, is important to remove any accumulated Pele's hair. **Once it settles on the roof, it can easily be swept or hosed off.** Depending on the frequency of eruptions, this may need to be done regularly. Tank Cleaning: Regular cleaning of the rainwater storage tanks will also help in reducing the risk of accumulated particles over time.

Comments : totally agree with maintenance.

4. Water Treatment Options
UV Sterilization: Ultraviolet (UV) light can inactivate some bacteria or pathogens that might be present in the water after filtration. While this won't remove physical particles, it can help with microbial contamination.
Quantum Disinfection: The Platinum whole house water disinfection kills pathogens and does NOT require electricity. You can drink, shower, wash your food and dishes in this water. https://www.tiloscleanwater.com/quantum-disinfection.html
Boiling or Chemical Treatment: If the water seems highly contaminated, boiling or using safe water treatment tablets (e.g., iodine or chlorine) could make the water safe for consumption.

Comments : the Quantam system sounds interesting

5. Use of Sedimentation Tanks
Implementing a sedimentation tank before the water reaches your main storage tank can be beneficial. This allows larger particles, including any Pele's hair that may have not been filtered out, to settle at the bottom before water enters the main storage.

Comments : all Options below include first flush/sedimentation tanks.

6. Additional Recommendations
Cover the Tanks: Ensure your rainwater storage tanks are tightly covered to prevent contamination from airborne particles. Might be worth using two covers.

Comments : agreed.

Adding a **Floating Intake Line** to the catchment systems then takes the water from about 18" from the top of tank - the cleanest water in the tank keeping your pump, water heater, filters cleaner longer.

Comments : we have never installed a floating filter intake. I have heard they are problematic and can get stuck. I think any small PeH particles that get into the tank will settle to the bottom.

Monitor Water Quality: Regular testing of the water, especially after significant volcanic activity, will help you assess any contamination and allow you to adjust your filtration systems accordingly.

Comments : acid, e-coli, etc. testing is most important. Wonder if a particle test to detect micro PeH be appropriate.

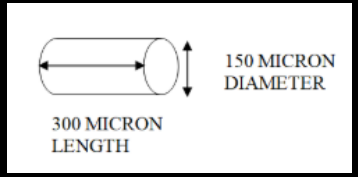
By **combining these strategies**, you can significantly reduce the risk of Pele's hair or micro-particles entering your rainwater harvesting system, ensuring the water is safe for household use.

Comments : totally agree PeH is a dangerous hazard

TEPHRA

PELE'S HAIR

Pele's hair has a golden yellow color and looks like human hair or dry straw. In sunlight, it has a shimmering gold color. Length varies considerably, but is typically 5 to 15 cm, and can be up to 2 m.[4] Hair diameter ranges from about 1 to 300 μm (0.001 to 0.3 mm).




Volcanic ash erupted on March 24, 2008, Halema'uma'u Crater, Kilauea Volcano, Hawai'i

VOLCANIC ASH

"Tephra" is the general term for volcanic rock fragments exploded or carried into the air during an eruption. Such fragments can range in size from less than 2 mm (0.08 inches) to more than 1 m (3.2 feet) in diameter. The smallest tephra is called volcanic ash, pieces of pulverized rock and volcanic glass the size of sand or silt. Tiny ash particles can be less than 0.001 mm (0.00004 inches) in diameter.

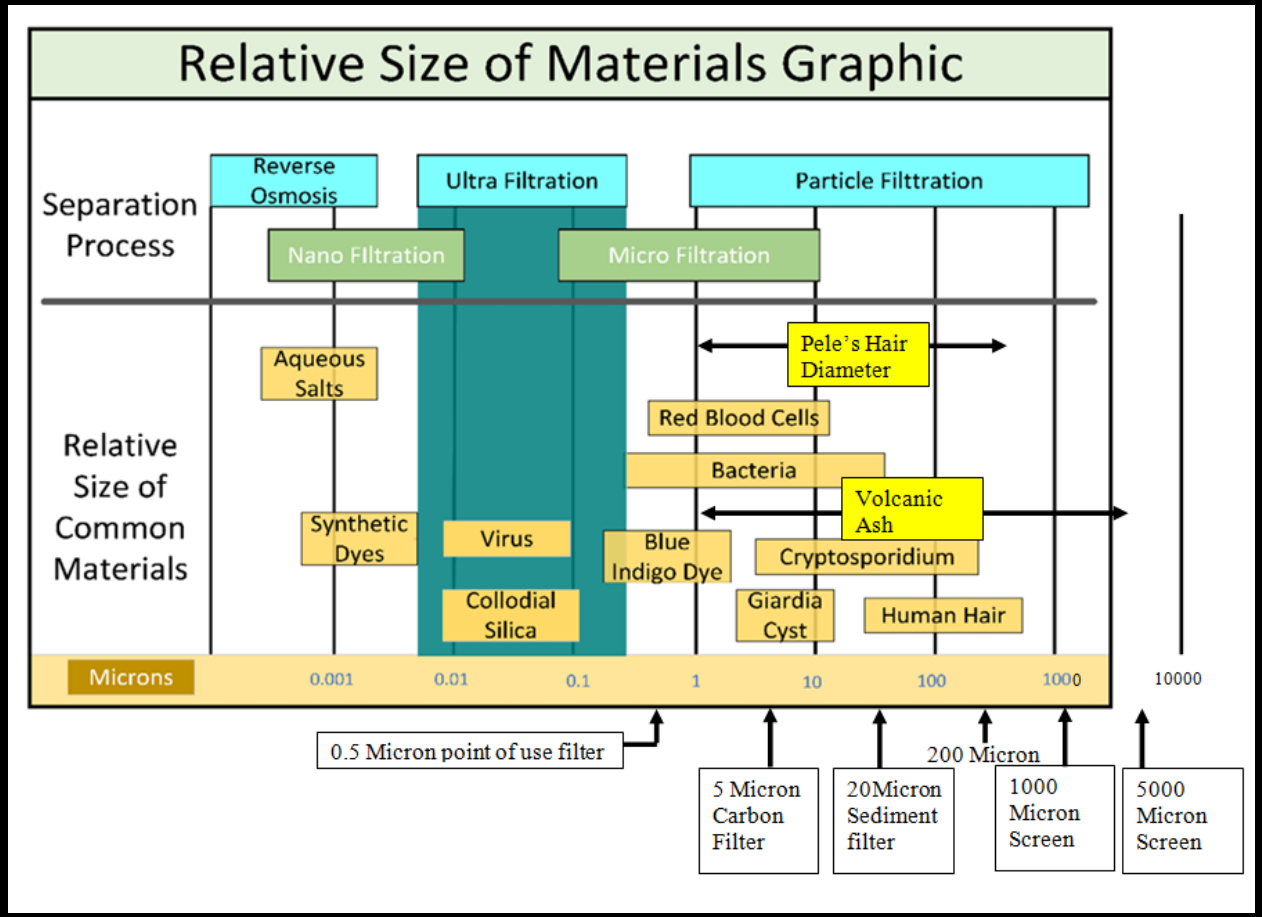

Tephra, including rock fragments, tiny spheres, and shards of volcanic glass, that was erupted from Halema'uma'u Crater, Kilauea Volcano, Hawai'i


November 10, 2025 — Pele's hair in Pāhala from Kīlauea episode 36

SHEET 10

Tephra and Pele's hair continue to litter the Volcano House's roof at Hawai'i Volcanoes National Park after Kīlauea's 41st episode. (Kevin Fujii/Civil Beat/2026)

SHEET 11

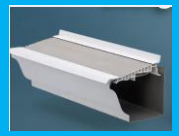


ARCSA PARTICLE SIZE CHART

SHEET 12

ROOF TO TANK PRE-FILTRATION

GUTTER GUARDS WITH
REVERSE CURVE



LEAF FILTER GUTTER
FILTERS WITH
275 MICRON SCREEN

GUTTERDOME GUTTER
WITH
440 MICRON SCREEN

LEAF ADVANCED WITH
1000 MICRON SCREEN

UNCLE TILO'S BASIC BAG
500-1000 MICRON APPROX

NYLON STOCKING
ON TANK INLET

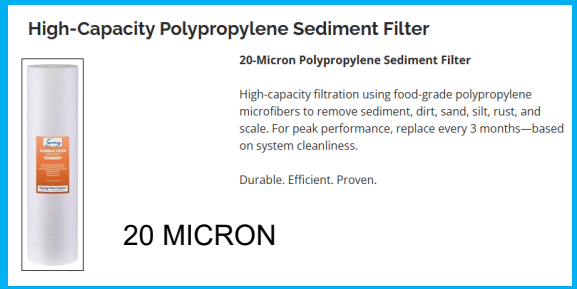
MAELSTROM FILTER
WITH
180 MICRON SCREEN

RMS WISY FILTER
WITH
280 MICRON SCREEN

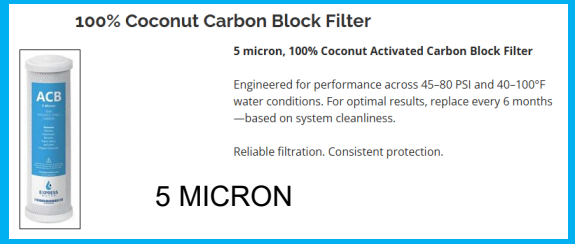
CENTRALIZED FIRST
FLUSH WITH DRAIN

LEAF CATCHER
WITH FIRST
FLUSH LEG.CAP

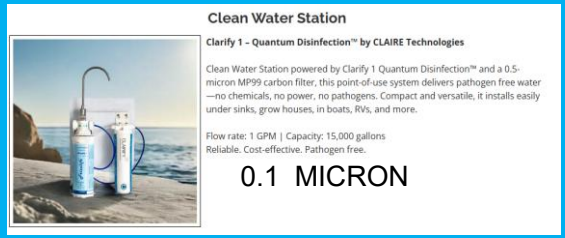
TANK TO HOUSE POST-FILTRATION



20 MICRON



5 MICRON



0.1 MICRON

REVISED 5-11-26

SHEET 13

3 PVC SDR 35
SANITARY TEE

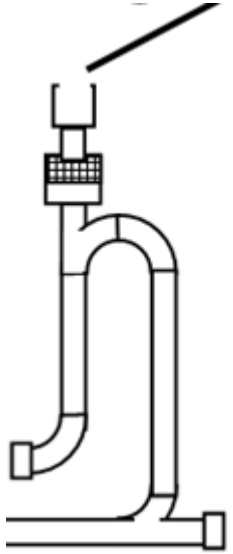
3" Sch 40 PVC Cap - FPT
Threaded 448-030

$4.78

3" Sch 40 PVC 90 Sweep Elbow
Soc 406-030SW

1 review

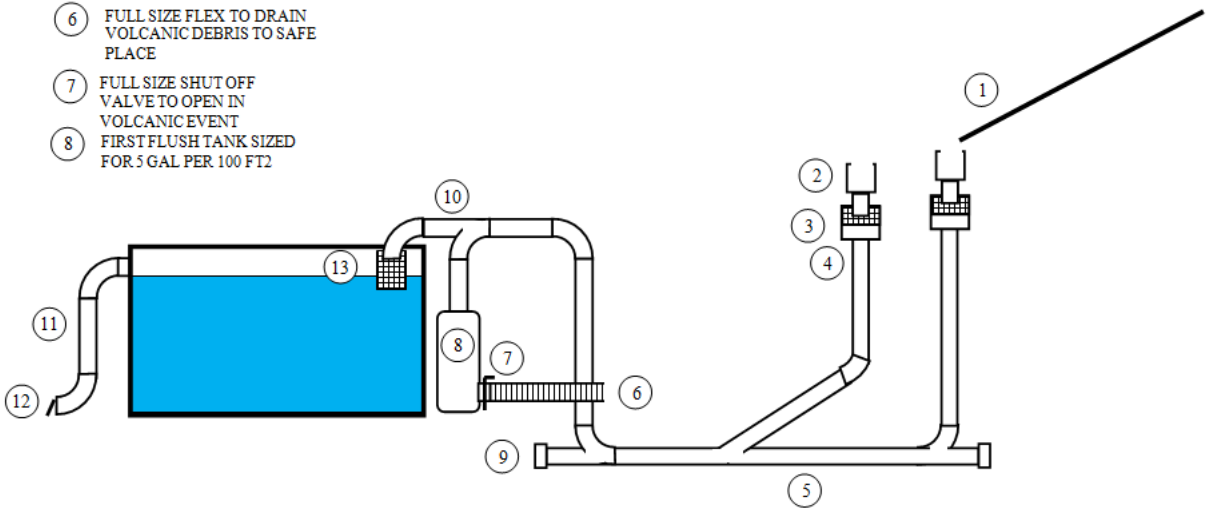
$10.81



ROOF TO TANK SYSTEM

SHEET 14

1. ROOF
2. GUTTER W/DOWNSPOUT
3. TYP LEAFCATCHER WITH 1000 MICRON SCREEN
4. RW PIPING TO TANK
5. ABOVE GRADE WET PIPING SYSTEM WITH CLEANOUT CAPS AT EACH END
6. FULL SIZE FLEX TO DRAIN VOLCANIC DEBRIS TO SAFE PLACE
7. FULL SIZE SHUT OFF VALVE TO OPEN IN VOLCANIC EVENT
8. FIRST FLUSH TANK SIZED FOR 5 GAL PER 100 FT2
9. UNSCREW CAPS BEFORE VOLCANIC EPISODE
10. RW TANK INLET SIZED FOR ROOF AREA SERVED
11. OVERFLOW SAME SIZE AS INLET
12. FLAPPER VALVE
13. TILO'S FILTER BAG



OPTION #1

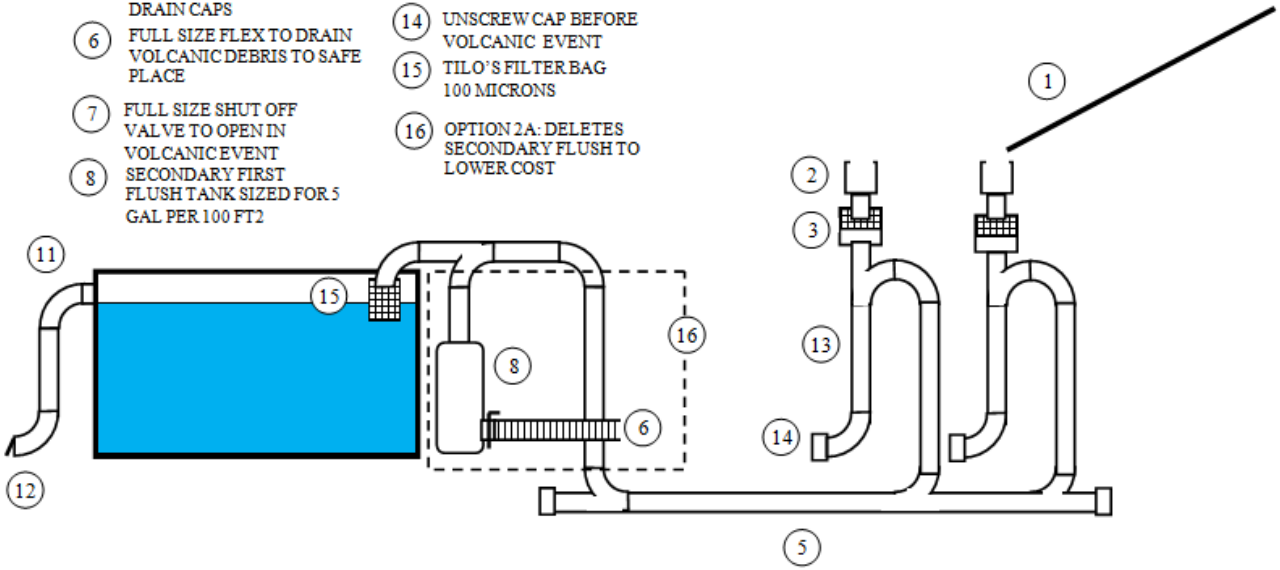
1 / RWH-1

POTABLE ROOF TO TANK WET RWH SYSTEM WITH LEAFCATCHER CENTRAL FIRST FLUSH

SCALE : NOT TO SCALE

REVISED : 4-26=26

1. ROOF
2. GUTTER W/DOWNSPOUT
3. TYP LEAFCATCHER WITH 1000 MICRON SCREEN
4. RW PIPING TO TANK
5. ABOVE GRADE WET PIPING SYSTEM WITH CLEANOUT DRAIN CAPS
6. FULL SIZE FLEX TO DRAIN VOLCANIC DEBRIS TO SAFE PLACE
7. FULL SIZE SHUT OFF VALVE TO OPEN IN VOLCANIC EVENT
8. SECONDARY FIRST FLUSH TANK SIZED FOR 5 GAL PER 100 FT2
9. UNSCREW CAPS BEFORE VOLCANIC EPISODE
10. RW TANK INLET SIZED FOR ROOF AREA SERVED
11. OVERFLOW SAME SIZE AS INLET
12. FLAPPER VALVE
13. PRIMARY FIRST FLUSH
14. UNSCREW CAP BEFORE VOLCANIC EVENT
15. TILO'S FILTER BAG 100 MICRONS
16. OPTION 2A: DELETES SECONDARY FLUSH TO LOWER COST



OPTION #2 and OPTION 2A

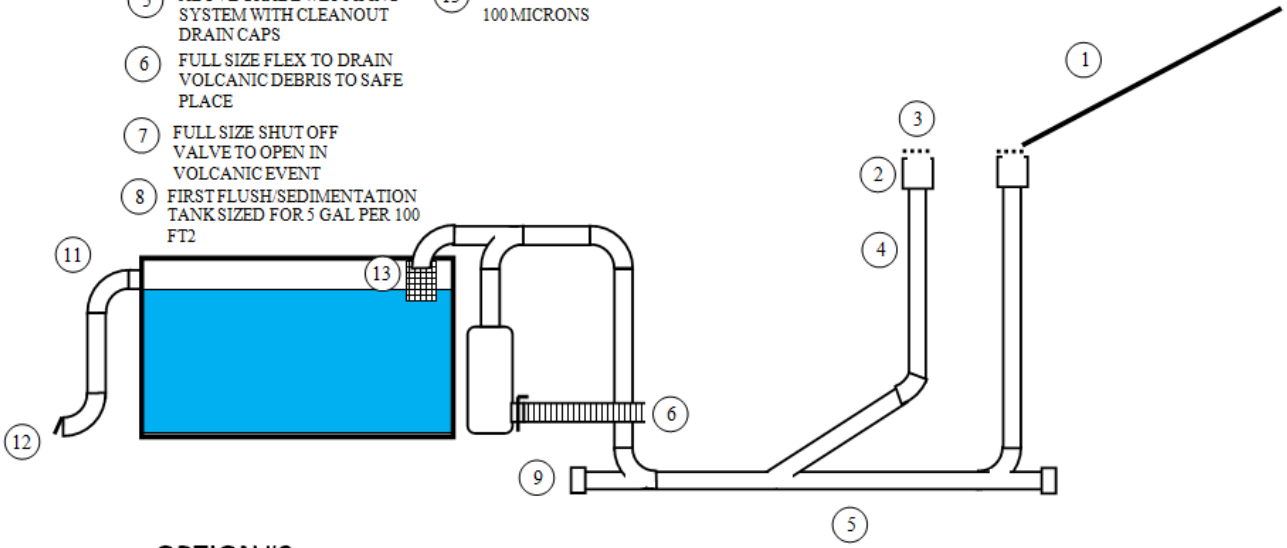
POTABLE ROOF TO TANK WET RWH SYSTEM WITH LEAFCATCHER/MULTI-STAGE FIRST FLUSH

2
RWH-1

SCALE : NOT TO SCALE

REVISED : 5-11-26

1. ROOF
2. GUTTER W/DOWNSPOUT
3. GUTTERDOME 440 MICRONS OR GUTTER GUARD
4. RW PIPING TO TANK
5. ABOVE GRADE WET PIPING SYSTEM WITH CLEANOUT DRAIN CAPS
6. FULL SIZE FLEX TO DRAIN VOLCANIC DEBRIS TO SAFE PLACE
7. FULL SIZE SHUT OFF VALVE TO OPEN IN VOLCANIC EVENT
8. FIRST FLUSH/SEDIMENTATION TANK SIZED FOR 5 GAL PER 100 FT2
9. UNCREW CAPS BEFORE VOLCANIC EPISODE
10. RW TANK INLET SIZED FOR ROOF AREA SERVED
11. OVERFLOW SAME SIZE AS INLET
12. FLAPPER VALVE
13. TILO'S FILTER BAG 100 MICRONS



OPTION #3

3 / RWH-1

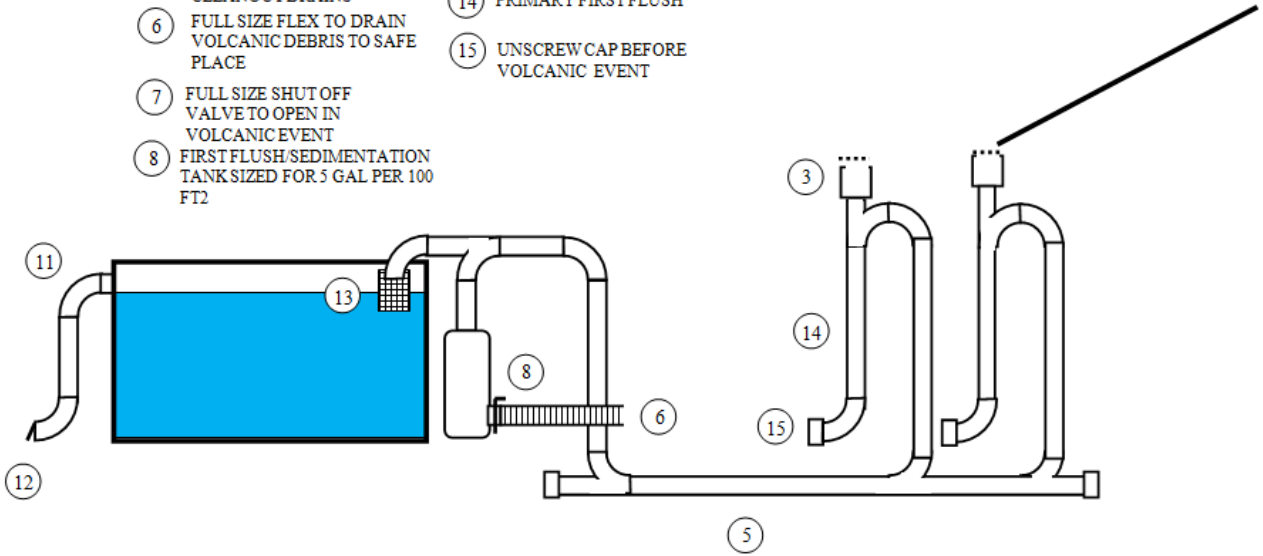
POTABLE ROOF TO TANK WET RWH SYSTEM WITH GUTTER FILTERS CENTRAL FIRST FLUSH

SCALE : NOT TO SCALE

REVISED : 4-26=26

SHEET 17

1. ROOF
2. GUTTER W/DOWNSPOUT
3. GUTTERDOME 440 MICRONS OR GUTTER GUARD
4. RW PIPING TO TANK
5. BELOW OR ABOVE GRADE WET PIPING SYSTEM WITH CLEANOUT DRAINS
6. FULL SIZE FLEX TO DRAIN VOLCANIC DEBRIS TO SAFE PLACE
7. FULL SIZE SHUT OFF VALVE TO OPEN IN VOLCANIC EVENT
8. FIRST FLUSH/SEDIMENTATION TANK SIZED FOR 5 GAL PER 100 FT2
9. UNSCREW CAPS BEFORE VOLCANIC EPISODE
10. RW TANK INLET SIZED FOR ROOF AREA SERVED
11. OVERFLOW SAME SIZE AS INLET
12. FLAPPER VALVE
13. TILO'S FILTER BAG 100 MICRONS
14. PRIMARY FIRST FLUSH
15. UNSCREW CAP BEFORE VOLCANIC EVENT



OPTION #4

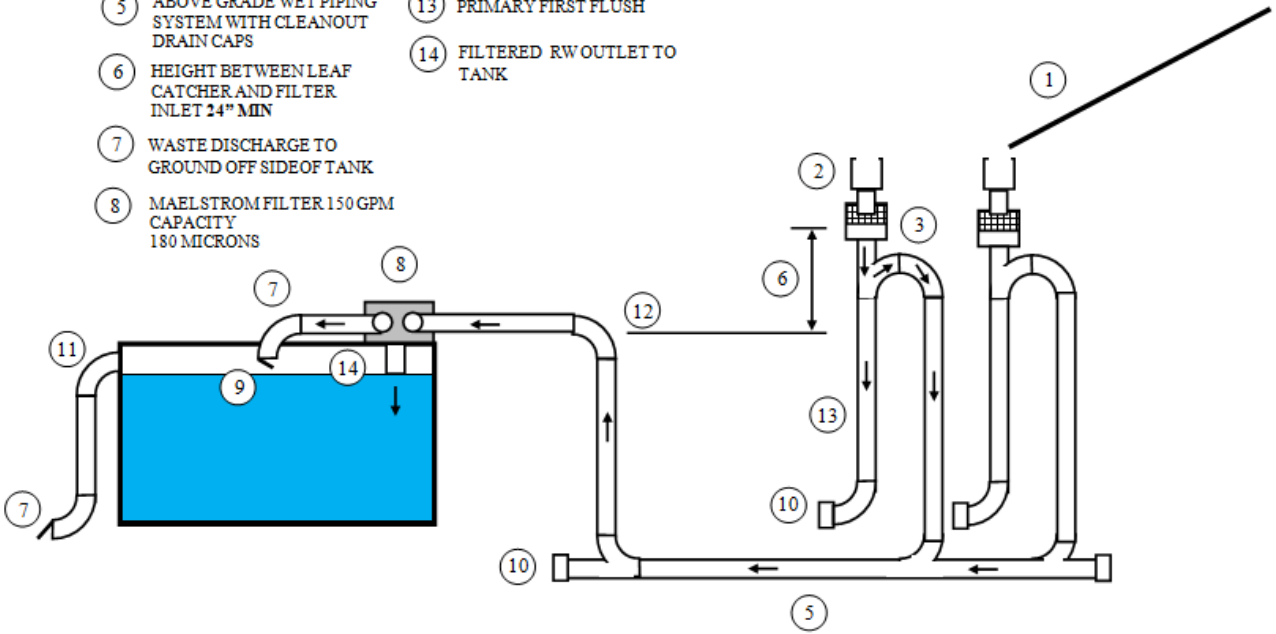
POTABLE ROOF TO TANK WET RWH SYSTEM WITH GUTTER FILTERS AND MULTI-STAGE FIRST FLUSH

4
RWH-1

SCALE : NOT TO SCALE

REVISED : 4-26=26

1. ROOF
2. GUTTER W/DOWNSPOUT
3. TYP LEAFCATCHER WITH 1000 MICRON SCREEN
4. RW PIPING TO TANK
5. ABOVE GRADE WET PIPING SYSTEM WITH CLEANOUT DRAIN CAPS
6. HEIGHT BETWEEN LEAF CATCHER AND FILTER INLET **24" MIN**
7. WASTE DISCHARGE TO GROUND OFF SIDE OF TANK
8. MAELSTROM FILTER 150 GPM CAPACITY 180 MICRONS
9. FLAPPER VALVE
10. UNSCREW CAPS BEFORE VOLCANIC EPISODE
11. OVERFLOW SAME SIZE AS INLET
12. RW TANK INLET SIZED FOR ROOF AREA SERVED
13. PRIMARY FIRST FLUSH
14. FILTERED RW OUTLET TO TANK



OPTION #5

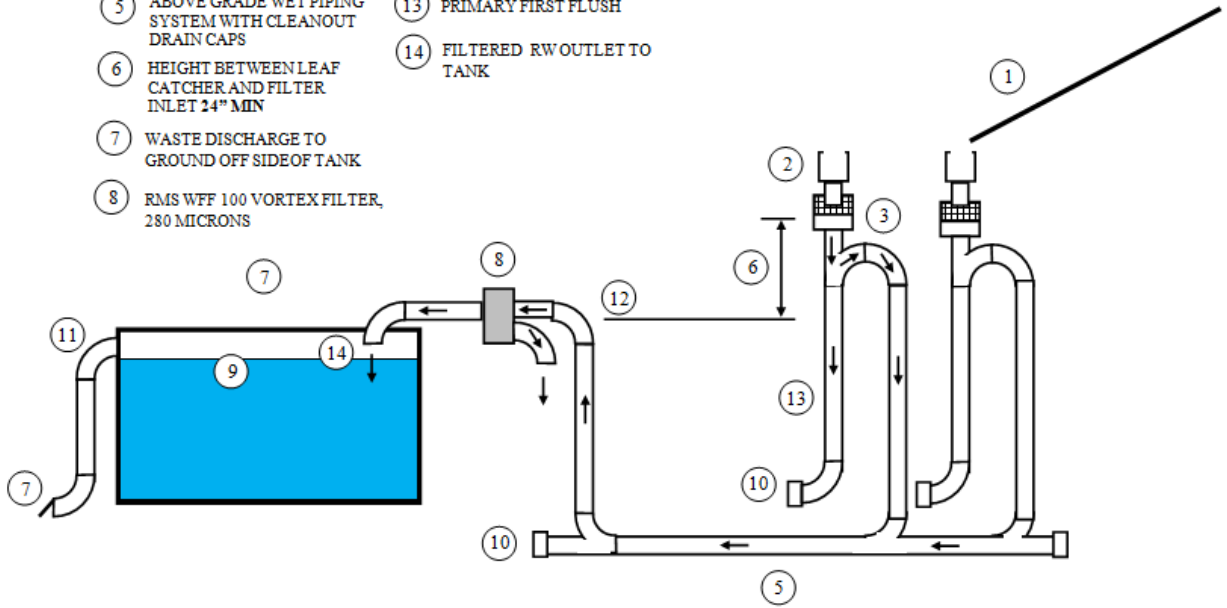
POTABLE ROOF TO TANK WET RWH SYSTEM WITH LEAFCATCHER/MAELSTROM FILTER

5
RWH-1

SCALE : NOT TO SCALE

REVISED : 5-9-26

1. ROOF
2. GUTTER W/DOWNSPOUT
3. TYP LEAFCATCHER WITH 1000 MICRON SCREEN
4. RW PIPING TO TANK
5. ABOVE GRADE WET PIPING SYSTEM WITH CLEANOUT DRAIN CAPS
6. HEIGHT BETWEEN LEAF CATCHER AND FILTER INLET **24" MIN**
7. WASTE DISCHARGE TO GROUND OFF SIDE OF TANK
8. RMS WFF 100 VORTEX FILTER, 280 MICRONS
9. FLAPPER VALVE
10. UNSCREW CAPS BEFORE VOLCANIC EPISODE
11. OVERFLOW SAME SIZE AS INLET
12. RW TANK INLET SIZED FOR ROOF AREA SERVED
13. PRIMARY FIRST FLUSH
14. FILTERED RW OUTLET TO TANK



OPTION #6

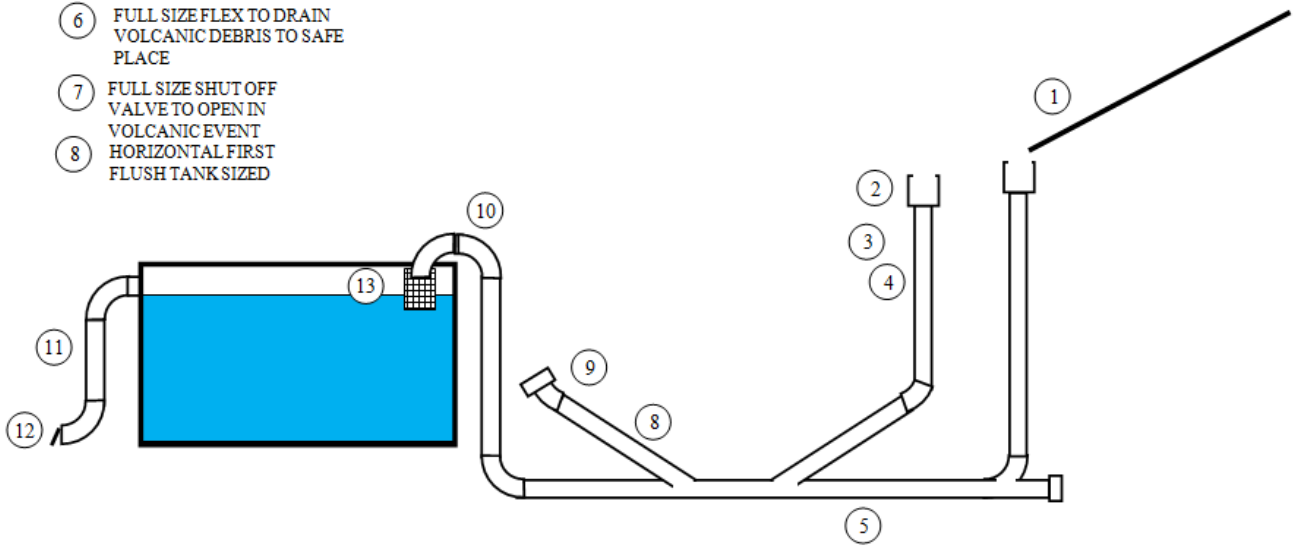
POTABLE ROOF TO TANK WET RWH SYSTEM WITH LEAFCATCHER/WFF 100 VORTEX FILTER

6
RWH-1

SCALE : NOT TO SCALE

REVISED : 5-9-26

1. ROOF
2. GUTTER W/DOWNSPOUT
3. DELETED
4. RW PIPING TO TANK
5. ABOVE GRADE WET PIPING SYSTEM WITH CLEANOUT CAPS AT EACH END
6. FULL SIZE FLEX TO DRAIN VOLCANIC DEBRIS TO SAFE PLACE
7. FULL SIZE SHUT OFF VALVE TO OPEN IN VOLCANIC EVENT
8. HORIZONTAL FIRST FLUSH TANK SIZED
9. UNSCREW CAPS BEFORE VOLCANIC EPISODE
10. RW TANK INLET SIZED FOR ROOF AREA SERVED
11. OVERFLOW SAME SIZE AS INLET
12. FLAPPER VALVE
13. TILO'S FILTER BAG



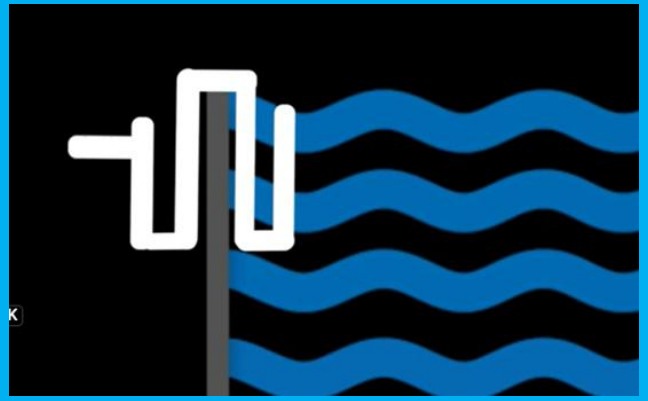
OPTION #7 : TILO'S SYSTEM

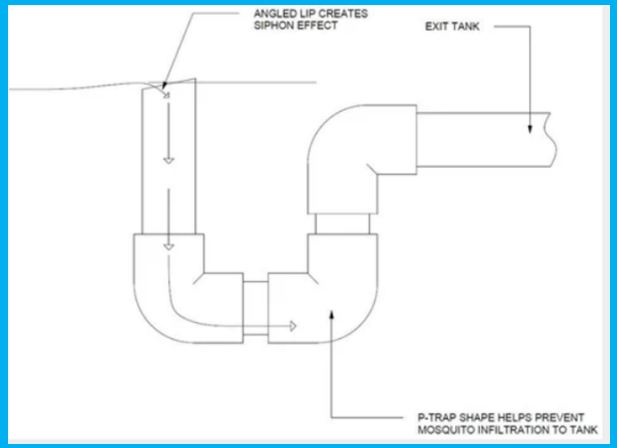
7
RWH-1

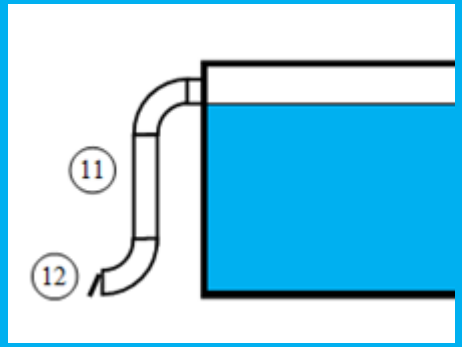
POTABLE ROOF TO TANK WET RWH SYSTEM CENTRAL HORIZONTAL FIRST FLUSH

SCALE : NOT TO SCALE

REVISED : 5-14-26







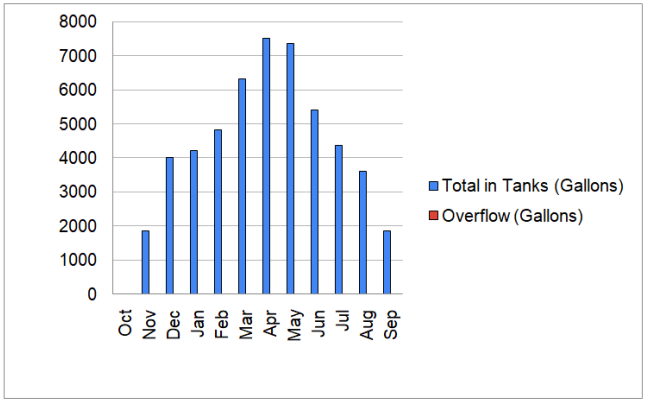
OVERFLOW OPTIONS

SHEET 22

4 per @ 50 gpd X 30 day/mo= = 6000 gal/mo

AVE RAINFALL	Total roof area (sf)	1000	Tank Volume (gal)	10000

	Average Rainfall (inches)	Gross Rain (Gallons)	Indoor Demand (Gallons)	Outdoor Demand (Gallons)	Net Gain (Gallons)	Total in Tanks (Gallons)	Overflow (Gallons)
Oct	11.12	5560	6,000	0	-440	0	0
Nov	15.71	7855	6,000	0	1855	1855	0
Dec	16.30	8150	6,000	0	2150	4005	0
Jan	12.44	6220	6,000	0	220	4225	0
Feb	13.21	6605	6,000	0	605	4830	0
Mar	15.00	7500	6,000	0	1500	6330	0
Apr	14.40	7200	6,000	0	1200	7530	0
May	11.67	5835	6,000	0	-165	7365	0
Jun	8.08	4040	6,000	0	-1960	5405	0
Jul	9.93	4965	6,000	0	-1035	4370	0
Aug	10.49	5245	6,000	0	-755	3615	0
Sep	8.49	4245	6,000	0	-1755	1860	0
Total	146.84	73420	72000	0			0



Total Demand	72000	
Rainwater Used	71560	99%
City Water Used	0	0%

AREA FT2		GAL/IN	INTENSITY IN/HR	FLOW GAL/HR	FLOW GPM	VEL FPS	PIPE SIZE IN	1ST FL GAL/100 FT2	1ST FL GAL	3" PIPE GAL/LF	PIPE LF
1000	0.5	500	6	3000	50	2	3	1	10	0.4	25

AREA FT2	80% EFF GAL/IN/F2	GAL/IN	INTENSITY IN/HR	FLOW GAL/HR	FLOW GPM	VEL FPS	PIPE SIZE IN	1ST FL GAL/100 FT2	1ST FL GAL	3" PIPE GAL/LF	PIPE LF
2000	0.5	1000	6	6000	100	2	4	1	20	0.4	50

AREA FT2		GAL/IN	INTENSITY IN/HR	FLOW GAL/HR	FLOW GPM	VEL FPS	PIPE SIZE IN	1ST FL GAL/100 FT2	1ST FL GAL	3" PIPE GAL/LF	PIPE LF
1000	0.5	500	6	3000	50	2	3	5	50	0.4	125

AREA FT2	80% EFF GAL/IN/F2	GAL/IN	INTENSITY IN/HR	FLOW GAL/HR	FLOW GPM	VEL FPS	PIPE SIZE IN	1ST FL GAL/100 FT2	1ST FL GAL	3" PIPE GAL/LF	PIPE LF
2000	0.5	1000	6	6000	100	2	4	5	100	0.4	250

RWH CALCULATIONS

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