OWNERS MANUAL

14069 JOKERS WILD LANE
GRASS VALLEY, CA 95945

1. WELCOME AND BACKGROUND

This house, at 14069 Jokers Wild Lane, Grass Valley, CA 95945, was designed and built by a physicist/astronomer. The primary goal of the home was to minimize the energy consumption of the home, while not abandoning standard construction practices. The original thought was to build with wood, the default material for residences. In the back of one's mind in regard to homes in the rural Sierra foothills is the threat of wildfire, home insurance problems, earthquakes, whatever.

When the parcel was purchased in 2000 it housed two single wide trailers and had a working well and septic system. The main attraction of the parcel was the south-facing slopes, with geometry favorable for using solar energy, especially for home heating in winter. Another advantage of parcel was that the customary breeze was up hill from the southwest corner which promotes cooling in summer evenings.

Browsing the subject of owner-builder home designs, the new owner encountered mention of homes built from steel. Steel! At once it was seen that this might be an answer to those nagging questions, especially regarding resistance to wildfire. Moreover, a specific home design, Autumn View, sold in kit form by Heritage Builders of Little Rock, AR [now Kodiak Homes] was a simple design that looked feasible.

The steel home kit has an engineered foundation, set by the footprint of the structural steel design. All the walls are non-load bearing. The windows, doors, internal walls, and all internals (water, electrical, drain, heating and cooling) are designed by the builder. The Autumn View footprint included a porch along the long side. It proved quite feasible to convert the porch into a passive solar room inside the home extending across the entire southern face of the house.

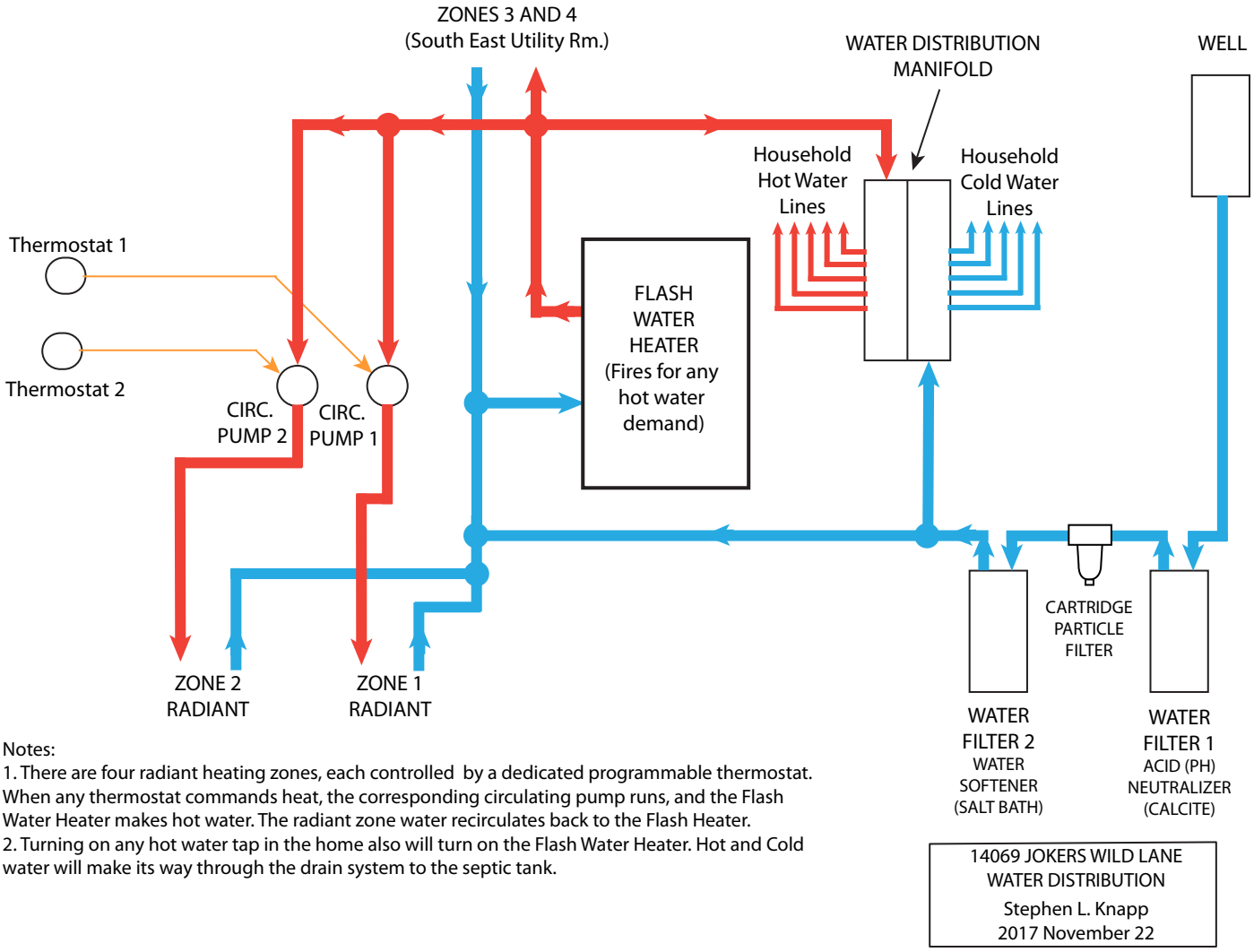
The design also permitted the envelope of the heated home to be very highly insulated; the attic is soffit-ventilated on all sides. Thus was started the detailed design and the building permit processes. The home design more than exceeded the Title 24 energy conservation requirements. The house was newly finished in 2007.

2. WATER AND HEATING SYSTEMS.

Friendly Note: The water and heating systems look complicated because they are unusual. This section should help you to see how simple they are.

Figure W-1 is a schematic drawing of the potable water systems inside the house. Basically, cold water comes from the well/pressure tank in the pump house; it passes through several filtering machines, after which it is distributed through the house, and also enters an "instantaneous" or

Flash Water Heater which is used to heat the filtered well water for distribution to sinks and also for the radiant heating within the concrete floor.



Notes:
1. There are four radiant heating zones, each controlled by a dedicated programmable thermostat. When any thermostat commands heat, the corresponding circulating pump runs, and the Flash Water Heater makes hot water. The radiant zone water recirculates back to the Flash Heater.
2. Turning on any hot water tap in the home also will turn on the Flash Water Heater. Hot and Cold water will make its way through the drain system to the septic tank.

Figure W-1

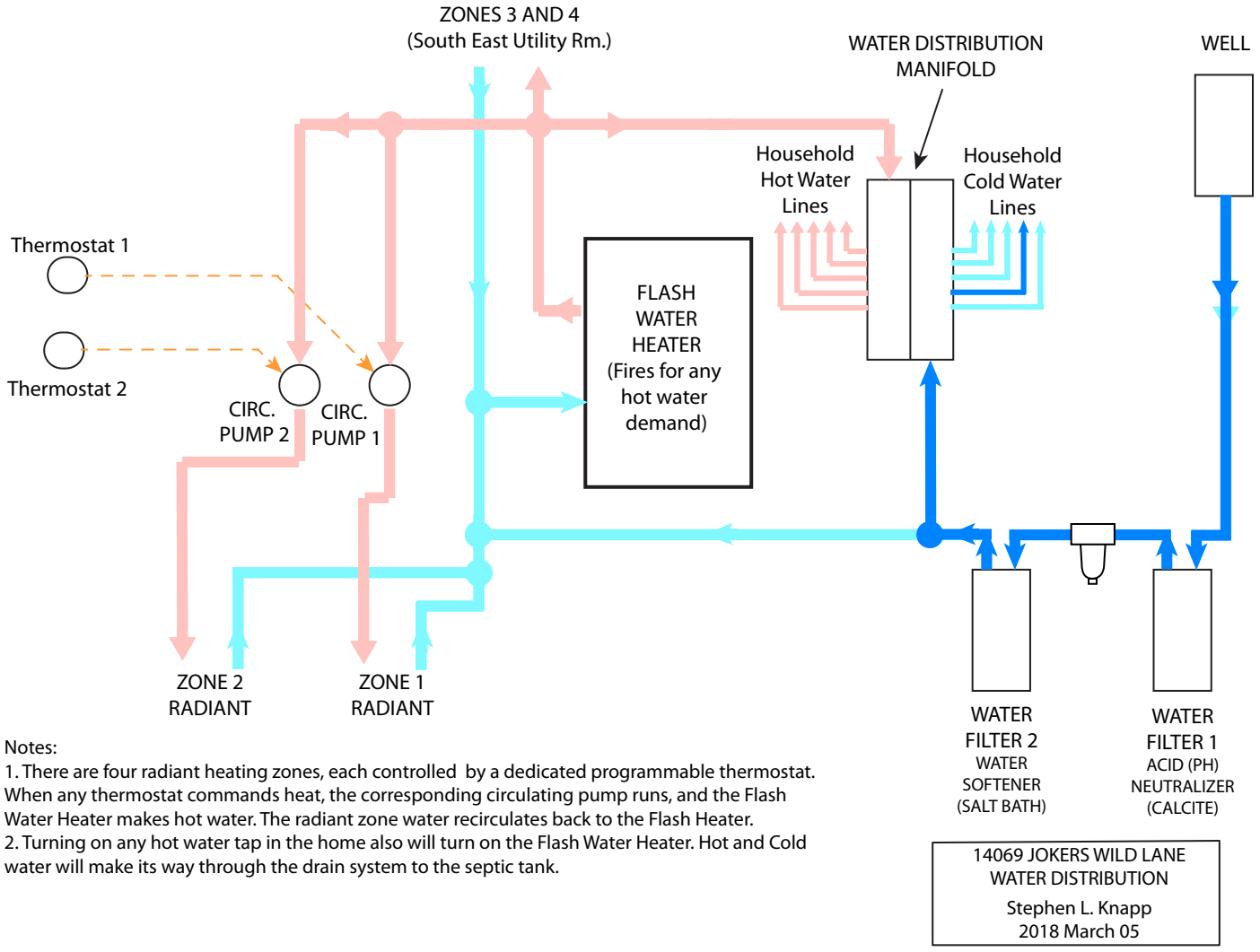
Refer to Figures W-2 through W-6 that follow this section. Figure W-2 is the last page of this guide and unfolds. Figure W-2 is a photomontage of the main water and heating components, located in the NW utility (laundry) room. The components are labeled by capital letters for reference. You may want to unfold Figure W-2 as you read this section. The water enters the house from the well running from right to left in Figure W-2.

Water comes from a well, located in the brown shed on the north. Water pressure is maintained by a pressure storage tank in the shed. The pressure tank holds about 25 gallons. When the tank pressure falls below about 28 lb./sq. ft., a pressure switch turns on the well pump until the pressure rises above 40. In an emergency, the well pump can be disconnected by throwing both circuit breakers (labelled “Well Pump B” and “Well Pump A”). The circuit breaker box is on the wall in the utility (laundry) room to the left of the outside door [Item S in Figure W-2].

Figures W-3 through W-6 give several schematic illustrations of how different water demands flow through the house system, using variations of Figure W-1 with heavy coloring to show the specific functions.

Drawing cold water, from a wash basin or shower or other tap is shown in Figure W-3:

Household Cold Water Example



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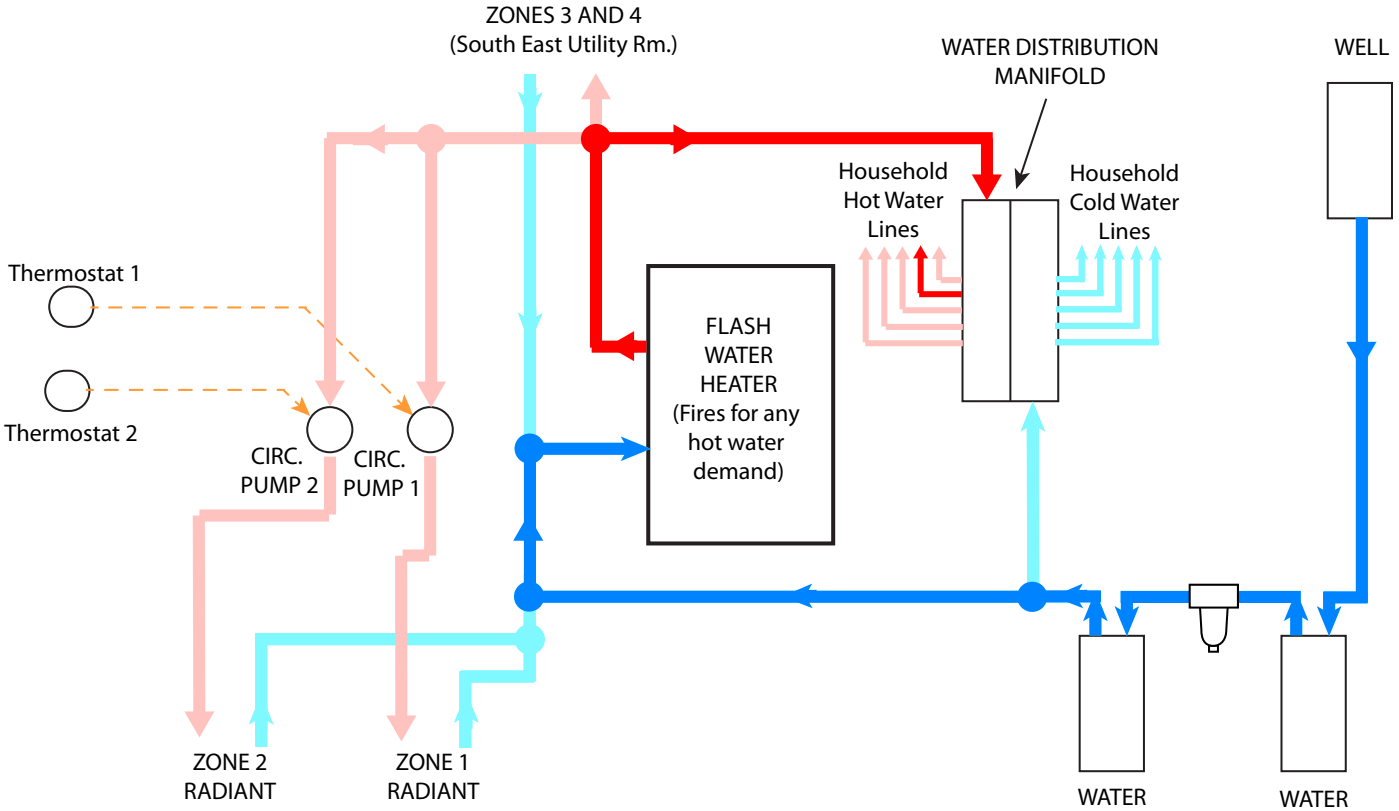
2. Turning on any hot water tap in the home also will turn on the Flash Water Heater. Hot and Cold water will make its way through the drain system to the septic tank.

Figure W-3

Drawing hot water, from a wash basin or shower or other tap is shown in Figure W-4:

Household Hot Water Example



Notes:
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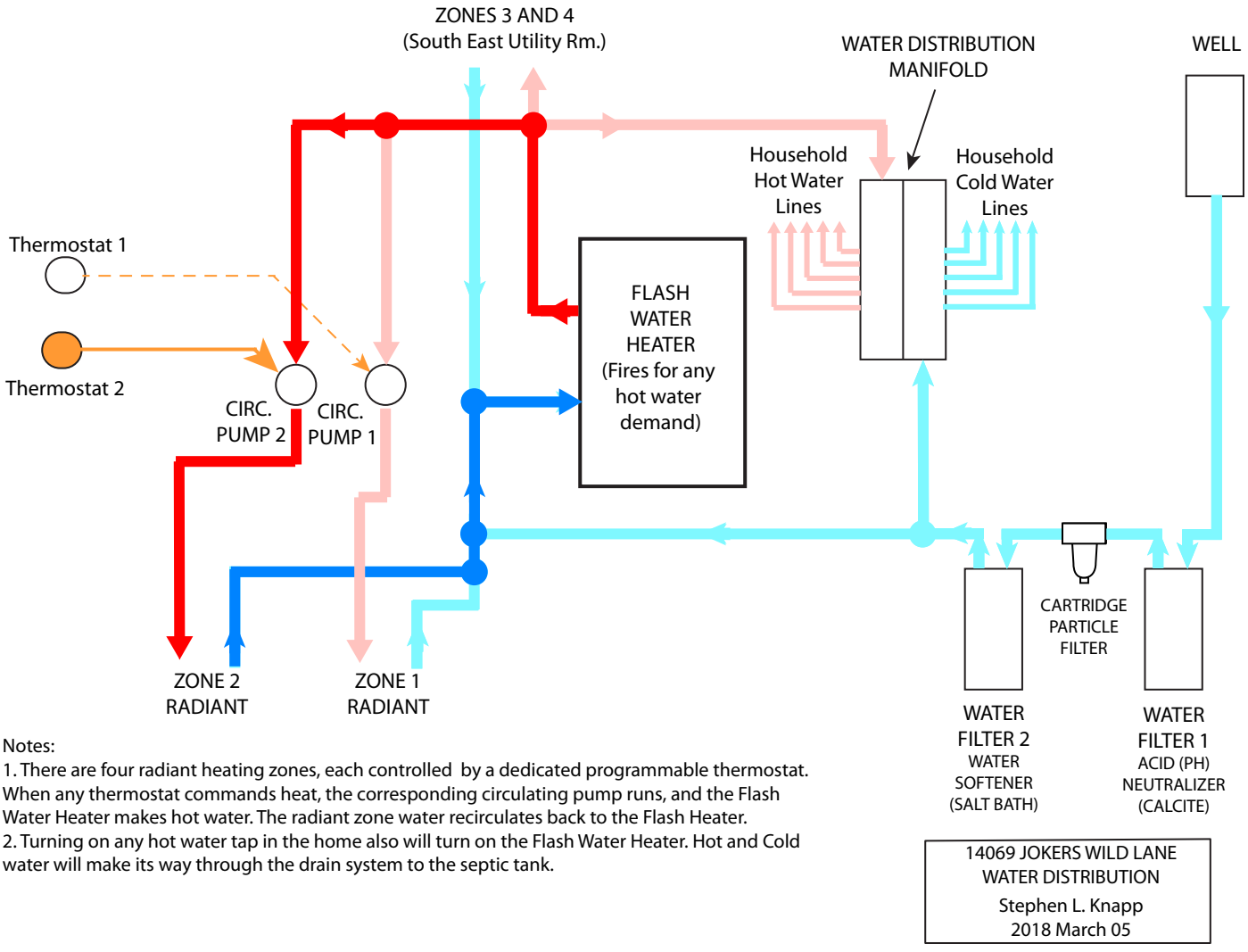
2. Turning on any hot water tap in the home also will turn on the Flash Water Heater. Hot and Cold water will make its way through the drain system to the septic tank.

Figure W-4

Radiant heat NW utility room example. Figure W-5 shows the case when radiant heating system thermostat #2 energizes circulating pump #2, which draw2 hot water from the flash water heater. The return cool water is recirculated back into the cold input to the water heater, and no water is drawn from the well/pressure tank.

Household Radiant Hot Water Example - NW Utility Room

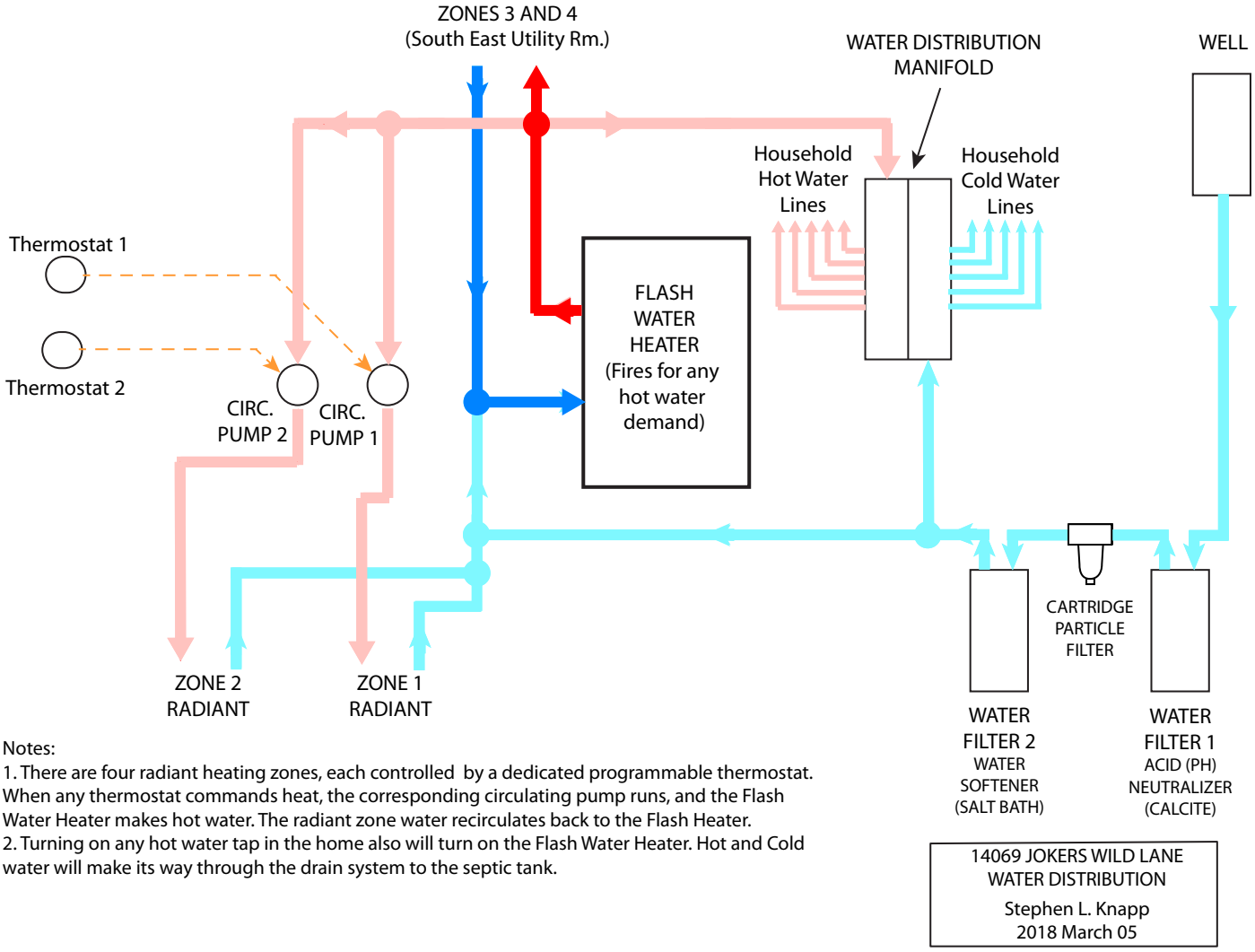


Notes:
1. There are four radiant heating zones, each controlled by a dedicated programmable thermostat. When any thermostat commands heat, the corresponding circulating pump runs, and the Flash Water Heater makes hot water. The radiant zone water recirculates back to the Flash Heater.
2. Turning on any hot water tap in the home also will turn on the Flash Water Heater. Hot and Cold water will make its way through the drain system to the septic tank.

Figure W-5

Radiant heat SE utility room example. Figure W-6 is similar to the previous, but shows radiant hot water circulating to loop #3 or loop #4, with the circulating pump in the SE utility room.

Household Radiant Hot Water Example - SE Utility Room



Notes:
1. There are four radiant heating zones, each controlled by a dedicated programmable thermostat. When any thermostat commands heat, the corresponding circulating pump runs, and the Flash Water Heater makes hot water. The radiant zone water recirculates back to the Flash Heater.
2. Turning on any hot water tap in the home also will turn on the Flash Water Heater. Hot and Cold water will make its way through the drain system to the septic tank.

Figure W-6

Figure W-2 is a photographic montage of the Water and Heating systems. The figure uses Identifying arrows and item labels A through S for individual components which are described separately in this section as follows.

A. HOUSE MAIN WATER VALVE AND PRESSURE GUAGE.

High in the NW corner of the utility room is the main water valve for water entering the house from the pressure tank in the pump house. A pressure guage is located below the valve.

The well water goes through two conditioning systems and a particle filter in the utility room.

B. ACID NEUTRALIZER FILTER

This first conditioning system is the mineral filter. It is is a slender tank that removes unwanted metals (manganese, iron, some others) from the raw well water, located to the right of the outside door. This filter system has a timer in a box at the top of the tank. The tank is back-washed every third night to remove the extracted metals. This back-wash event is set to occur at about 2AM, and takes about 25 mins. During the back-wash operation the house water bypasses this necessary filter. **Important: the domestic water should not be used during the back-wash operation and this is why it is set for sleeping time.** The reason for this prohibition is to prevent unwanted minerals from reaching the radiant heating tubing buried in the concrete floor. The timer system will lose its time setting if there is a failure of the AC electric power to the house, which does occasionally happen in this rural location (the microwave clock will stop and the stove clock will blink). If this happens you will need to reset the time on the filter timer, as described below.

When the house is empty for multiple days, it is recommended to turn off the power to the filter timer so the back-wash is disabled to save well water. This is done with the switch built into the wall socket just to the lower right of the outside door. The timer system has to be operating when the house is occupied as the filter system must remain clean by back-washing every third night of use.

Note that the back-wash schedule of every third night was suitable for a single occupant with low water needs, this may need to be adjusted when typical water usage is greater. Consult the operation manual for the acid neutralizing timer box, in the house documents.

How to set the filter timer. If there has been a power failure of more than a few minutes, or if you find the filter timer power off when you arrive, then you must set the time of day in the timer box on top of the slender tank and turn the power back on. To set the time of day, (1) make sure the timer power is switched off at the outlet on the wall to the lower right of the outside door: (2) open the glass door to the timer; (3) press in the red button (a small gear) and rotate the outer black wheel (a big gear) with hours on the circumference to the correct time at the arrow, (4) gently release the red button to reengage the small red gear (you may need to jiggle the big back hour gear so the red gear teeth fit in); and then switch the AC power back on at the wall outlet switch. You can hear a small clockwork motor running when the AC power is ON. The default setting for the back-wash operation is 2AM, as mentioned above.

Maintenance: The tall cylinder contains calcite, a mineral that neutralizes acid and helps to remove minerals like iron and manganese, which will coat the interior walls of all the PEX tubing used in the water heating and domestic water distribution systems. There is a pressure sealing cap on the side of the top of the tank. This gives access to the calcite inside. TURN OFF THE WATER FROM THE PRESSURE TANK BY CLOSING THE HOUSE VALVE "A" BEFORE OPENING THE TANK. Turn on the cold water tap at the laundry basin to relieve any pressure, but be prepared with a towel to catch dripping from the cap. Then open the cap (keeping the O-ring clean). Use a yardstick or equivalent to measure the top of the calcite. The calcite should be raised to 18" below the cap but not higher. To add calcite, use a measuring cup and the funnel to carefully add calcite to the 18" level. When replacing the pressure cap, clean the O-ring and add vaseline if needed.

C. PARTICLE FILTER
D1. SERVICE VALVE.

Filtered water leaves the acid neutralizer and passes in the ceiling, down to the main service valve (D1 in Figure W-2). The main service valve is used when replacing or cleaning the filter insert in the particle filter (C). The service valve has three positions: Green for normal operation; Yellow for bypassing the Kinetico System (not recommended); and Red for turning off the water entirely.

Both the Service Valve and the Particle Filter are part of the Kinetico Water Softener System, described in the next section. The filter is serviced as needed according to the Kinetico owners manual using the link in the next section.

D. KINETICO WATER SOFTENER SYSTEM.

The second conditioning system is a softening system, comprising the grey tub and the double black cylinder units. It does not require attention unless the salt in the grey tub needs replenishing; the salt should be kept full to well above the water line in the tub. Salt pellets are the preferred form of salt and are available at most supermarkets and elsewhere. When the salt water is seen above the salt pellets it is time to add more salt. It will not need attention over periods of days or weeks depending on water use. The Kinetico has a back-wash cycle also, but uses a double tank system so that one tank may be back-washed while the other is in service. The back-wash cycle uses the salt bath, which is the large gray tub. **Maintenance:** Check the salt bath tub by lifting the black top off. The salt pellets should rise above the level of the water and cover it. The salt is gradually consumed during the back-wash cycles, so regularly check on the salt. The operation of the Kinetico is entirely by water pressure and consumption, as there is an internal turbine mechanism with no electricity required.

A general user manual for the Kinetico water softening system is found here (https://www.kinetico.com/media/259764/16522_manual_owners_premier_series_xp_02142018.pdf). Under conditions of low water usage, a salt bridge can develop in the float valve within the gray salt tub. Such a bridge can be dislodged with a broom handle or by removing the valve assembly from the tub and inspecting for free movement; see the owner's manual at the link above.

E. WATER DISTRIBUTION MANIFOLD

All water in the house has been filtered and is potable. Hot and cold water is distributed by the water manifold E. The manifold uses individual water lines of PEX tubing to supply each hot and cold water faucet throughout the house, and the on-off valves for each faucet are located in the manifold, with blue for cold and red for hot. Filtered cold water is fed into the manifold bottom, and filtered hot is fed fed into the manifold at the top from the flash water heater [F].

F. FLASH HOT WATER HEATER

Cold water is heated on demand by the Flash Water Heater. Keep in mind that there is a two part delay for hot water to reach its destination. The first part is the time it takes for the flash heater to bring cold water to hot, and the second is the time for the water to travel to the destination.

G. WATER HEATER AIR INTAKE

Air is supplied to the flash water heater by this pipe which extends through the wall to the outside.

H. WATER HEATER PROPANE SUPPLY PIPE

This pipe brings propane to the flash water heater. Note that there is a buried propane line from the tank outside the fence. The buried line runs from the tank to the house, adjacent to the west side of the pump house and marked by a vertical piece of schedule 80 conduit standing vertically near the chain link fence. The propane is available in three locations on the north and east sides of the house. The line at east side near the door was intended for a future water heater that has not been necessary.

I. EXPANSION TANK

The expansion tank helps to absorb any sudden changes in water pressure. There is an air bladder inside, and the pressure should be checked occasionally according to the manufacturer's recommendations.

There is a pressure gauge above the expansion tank. The pressure normally falls in the range 25-45 PSI, depending on the state of the pressure tank at the well.

J. WATER PIPES TO THE SE UTILITY CLOSET

The arrows point to the hot water to and the return cold water pipes that pass to the SE utility closet. They connect there to the two radiant heating loops 3 and 4

K. CIRCULATING PUMPS 1 AND 2

Hot water is circulated inside the concrete floor of the house. There are four separate “zones”, and each zone has a separate programmable thermostat, a dedicated circulating pump, and 1 to 3 loops. The arrows point to the two circulating pumps in the NW utility room. Each pump sends hot water from the flash heater down into a manifold that distributes the hot water to the connected loops in that zone. The return cool water from the loops are joined to return the cool water from that zone to the input of the flash heater.

L. PEX TUBING FOR RADIANT HEATING 1 AND 2

About 2000 feet of PEX tubing are embedded in the concrete slab that is the house floor. Here is where the hot water enters the slab for zones 1 and 2, and where the cool water returns. Each circulating pump feeds a manifold below which divides the hot water to separate PEX loops operating in parallel in that zone. The hot water PEX lines are wrapped with insulation throughout the house. Also below the circulating pumps, close to the wall, are the manifolds which join the returning cooled water in the zone’s loops for returning to the cold water line into the flash water heater.

M. THERMOSTAT INTERFACE AND IN-SLAB TEMPERATURE DISPLAY

The floor area in the house is divided into four zones, each with a separate circulating pump. Each zone has its own thermostat for controlling the corresponding circulating pump. There are four thermostats in the house, one to control each the circulating pump for that zone.

Each circulating pump runs on 120VAC. The electronics contains interface electronics to convert the low voltage signal from the thermostat to the AC line voltage of the pumps.

Ten temperature sensors were placed in the concrete slab (floor) when the concrete was poured. The electronics contains the circuitry needed to display each temperature inside the concrete slab as it is measured by the sensors, and the temperature display is sequential. The graphics above shows the plan view of the slab and walls. The red LED lamps illuminate to show the approximate location of the temperature displayed.

N. CIRCULATING PUMPS 3 AND 4

The circulating pumps for zones 3 and 4 are locate in the SE utility closet. The hot water from the water heater is brought to the closet by insulated PEX tubing which runs above the ceiling panels below the attic insulation. See item K.

O. PEX TUBING FOR RADIANT HEATING 3 AND 4

Here in the SE utility closet are the PEX lines for hot water into the slab and cooler return water leaving the slab, for zones 3 and 4. See item L above.

P. PEX TUBING FOR THE SUN ROOM

Pex tubing for two interleaved loops was installed in place when the concrete slab was poured. But these two loops, available here in the SE utility room, were never connected. The intention is to use these loops for circulating hot water from solar hot water in a future with both solar hot water and solar PV panels on the roof. The energy conservation performance of the home has been so satisfactory that it was judged unnecessary (but using propane as needed).

R. VALVES FOR THE OUTSIDE HOSE BIBS

It is wise to shut off the water supply to the two outside hose bibs during the cold season, to prevent expensive damage from freezing. The shut off valves for the two outside hose bibs are contained inside the panel pointed by the arrow R. Remove the cover and use the black plastic wrench which clicks into the manifold. Too prevent freezing in winter, it is recommended to cover the outside hose bibs with the styrofoam covers kept in the SE utility closet.

S. THE AC CIRCUIT BREAKER BOX

Here is the AC circuit breaker box. Each breaker is labeled. Note the master circuit breakers are outside the house wall behind the breaker box.

Use the outside breaker box to disconnect the house from PG&E when using a generator. **Caution:** Never connect a generator to the house circuits (in the pump house) without disconnecting the home from the grid.

3. MORE INFORMATION ON HEATING, THERMOSTATS, AND WATER

Hot water for drinking and for house heating is supplied by the instantaneous propane water heater on the wall of the NW utility room. It starts heating hot water when any demand occurs, either by turning on a hot water tap at any sink or shower, or if a wall thermostat demands house heating. You can usually hear internal fans running when it is heating.

All heating thermostats contain internal clocks and are battery powered. In the cold seasons they are set to turn on the heat starting about 4AM and stopping during the day, in stages. The early start time is employed because it takes a few hours to heat the concrete floor. Each thermostat controls a separate circulating pump, which allows individual control of the four

separate area zones of the heated floor space in the house. The thermostat for the guest bedroom can be set for a lower temperature than the other three if the room is not heavily used, in order to save fuel.

Thermostat standby mode. In warm seasons or when the house is to be unoccupied, the thermostats are set to a standby mode to reduce the heating. Standby mode is set or unset using a button under the front face of the thermostat. Open the front face, which is hinged at the bottom, by pulling out on the tab at the top front center of the front face and the face will drop down. Press the top middle button, labeled “SDP” once to change to standby, and once to change back to normal. You will see a label (white on black) indicating SDP mode on the display. Replace the front face by lifting up and rotating it back in place.You can also change the target temperature manually at any time by pressing the up and down buttons on the left front of the thermostat, but remember the concrete is very slow to respond.

Water supply is a concern because of the persistent drought in CA. The well was drilled by a neighbor, who told me it was "a good well". It is around 90 ft deep, rather shallow compared to many nearby wells. Note that the property is directly above the old Arrowhead Mine. The well has never failed to produce strongly since the property was developed, starting in 2001, under single occupancy and was tested at over 20 gal/min when the parcel was bought in 2001.

Water conservation practices are recommended. The most important and easy to do is to not flush the toilet every time.

4. SUNSPACE (SUNROOM) AND SLIDING PATIO DOORS

The entire south of the house comprises a sunspace designed for passive solar heating and the sliding patio doors to the interior are used as an adjustable heat barrier. On sunny days in late fall, winter, and early spring, the sunspace acts as a passive solar collector/heater. The patio doors have internal venetian miniblinds that can be raised and lowered, and also opened and closed, by gently moving the one lever that is on the right side of the inside frame. The lever moves up and down most of the length of the glass, but small movements changes the angle of the miniblinds. Using the sliding doors and the miniblinds, the heat flow into or out of the interior can be controlled. Do not force the adjusting lever on the miniblinds or move it too abruptly. The patio doors may be slid open and closed of course; in cold weather on sunny days they are normally open to provide passive heating to the main room and master bedroom.

5. ADDITIONAL TOPICS

Bathrooms

Try to economize on water usage. Note that the master bathroom has additional radiant heating to maintain a warmer floor during cold winter conditions.

Kitchen
The appliances are very standard. The owners manuals for all appliances are located in the top drawer next to the refrigerator.

Sinks
There is no disposal. This house uses a septic tank system and composting is recommended.

Lighting
About 80% of the lighting in the home is incandescent ceiling lights. Many have dimmers and multiple switches. At night, almost every room has one light switch with a dim yellow light when it is off. The dim yellow lights are to help find the switches in the dark.

Walls and Concrete Slab
The concrete slab comprises about 32 cu. yd. concrete and about 1900ft of PEX tubing for hot water. The slab is about 3.5 inches thick near the SE corner and is about 4.5 inches thick on the opposite diagonal at the NW corner, with the PEX midway tied to a steel reinforcing mesh. Drilling in the slab (e.g., changing a wall) IS NOT RECOMMENDED.
The walls contain steel studs in the shape of a squared-up “C”. A standard stud finder will locate the studs. But there are steel diagonal straps (shear prevention) in several locations, and you may need to study the construction photographs for reference. Self-drilling steel screws are recommended for hanging on walls.

Fence and Keys
All three house doors have the same key for the deadbolts. The house is surrounded by a chain link fence. The fence has four gates, all with padlocks using the same key. In the past, the person-gate at the south and the vehicle gate at the northeast have their padlocks in place, but with the clasps open; these are the gates not opening onto the driveway parking area. The fence is to keep animals, usually deer or an occasional bear, away from the house and pets.

Septic Tank and Plumbing
The main water drain line (4” ABS) emerges from the house on the east side approximately in line with the toilet in the guest bathroom, and is buried outside the east wall in an angle toward the west end of the septic tank. Prior to building the house, the parcel had two single-wide trailers located in the clearing immediately east of the large tree just east of the home. The existing sewer line extended from the septic tank to the two trailers. When the house was built, its 4” septic drain line was connected to the existing sewer line with a “Y” union, located between the two trees closest to the SE corner of the house. The preexisting drain line used by the absent single-wides is available for future use (for example, in a future garage/pump house/etc., and is marked by a vertical white schedule 40 pipe over a vertical piece of rebar.

Conduits for Connecting to the Outside
When the house was designed, it included several provisions for connecting external electronics to the outside. These consist of schedule 80 conduits from the attic to four external locations: (1) Two conduits run from the top of the west wall out to below the SW corner below the retaining

wall; they are intended for external TV/radio antenna lines and a separate conduit for AC power intended for electricity for a future patio below the retaining wall. (2) Similarly, a conduit runs from the SE corner of the attic out to below the retaining wall at the SE end. (3) A schedule 80 conduit from the NE corner of the attic out to the pump house for running electric power (220 volt high current) for the well pump), and for internet/phone lines. (4) A schedule 80 conduit is buried from the attic at the east wall out eastward about 12.5 ft., marked by a vertical rebar with a protective cap; this is intended to facilitate communications to a possible future structure east and north of the house.

The Future Hot Tub

Hot and cold water lines are hidden in the external sunroom wall toward the west end, and are behind a removable panel low on the wall. The lines are capped behind the panel for future use and the shut off valves are buried under insulation in the attic near the SW corner. The idea was to install a hot tub in the sunroom sometime in the future.

Smoke Alarms

There is one smoke alarm in each bedroom, and they are interconnected as required by code. The alarms are easily triggered by fumes from cooking (especially frying). By all means use the ventilation fan on the north wall. Perhaps the smoke alarms are not so critical in a house that is not flammable. The CO2 alarm is new, so its response to cooking fumes is unknown. The house is fairly “tight”, so an elevated concentration of CO2 is cause for immediate ventilation and investigation.

6. FIRST THINGS TO CHECK WHEN RETURNING FROM A TRIP.

Check for Electric Power. Try a light switch. Strong storms sometimes result in loss of AC power. A 240 VAC generator (6500 watt) is required by the well pump, and there are a suitable electric cables in the pump house. Remember to disconnect the PG&E house power at the outside switchbox when you are using any generator; do this by setting both of the main circuit breakers to “Off”.

Well and Water filter power. (1) Before doing anything in the house, check that the electric power is on. If it is not, it will be necessary to isolate the house from the PG&E electric service (the grid), and use a generator until service is restored. (2) Set the time for the water filter timer as described in section B above in “How to set the filter timer”, and then turn on the filter timer power.

Check Thermostats. The thermostats should be changed from standby mode to normal, particularly if the weather is cold and heating is required. This is described above in “Thermostat standby mode”. Remember that the radiant heating system takes several hours to heat the concrete floor.

Written by
Stephen L. Knapp, Ph.D.

Revised 16 July 2019

Note: The author has written this document as a “best effort” in the interests of helping the owner get an understanding of the house systems and characteristics. The author assumes no liability whatsoever as a result of errors or other imperfections herein.