PROPOSALS SELECTED FOR THE DEVELOPMENT OF WORKING PROTOTYPES IN PHASE 3

Alaska Water and Sewer Challenge

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The Alaska Water and Sewer Challenge
Phase 3: Development and Testing of Pilot Systems
Division of Water, Dept. of Environmental Conservation
State of Alaska

Summary Table of Proposed Systems

Teams	Water hauled in (gallons/day)	Wastewater hauled out (gallons/day)	Daily water use per person (gallons/day)	Total water use in house of of 4 (gallons/day)	Operation & Maintenance Cost per month	Water Sources	Notes
DOWL Alaska (Version D)	12.9 *	14.1 *	15.0	60.0	$154	rain, ice melt, untreated water source	* Flow between fill and empty for 310-gallon water and waste storage tanks.
Summit Consulting	13	7.5	15.4	61.5	$130	rain, ice melt, river, treated water from washeteria	-
University of Alaska Anchorage	10.6	3.6 *	15.0	60.0	$126	rain, river, washeteria	*Additional 6.1 gal of treated onsite surface discharge
Target	*Acceptable/feasible by users*		*15*	*60*	*$135*	*NA*	-

Note : Teams used different assumptions about capital cost multipliers in estimating the capital cost per home, which resulted in a wide range of estimates.

Water Reuse:	Water reused *from ->*	Clothes washer	Toilet	Kitchen sink	Shower	Bathroom sink	Dishwasher *(optional)*	Notes
Graywater and/or Black water	DOWL	yes	no	no	yes	yes	NA	Version D
	Summit	yes	no	yes	yes	yes	yes	Only team proposing dishwasher
	UAA	yes	yes (urine only for toilet flushing)	yes (for toilet flushing)	yes	yes	NA	(Liquid) toilet and kitchen sink wastewater reused for flushing only, RO concentrate for haul-away
	Reused water *for ->*	**Clothes washer**	**Toilet**	**Kitchen sink (non-potable tap)**	**Shower**	**Bathroom sink**	**Dishwasher *(optional)***	**Notes**
	DOWL	yes	yes	yes	yes	yes	NA	POU ceramic disk filter for potable water
	Summit	yes	yes	available, up to user's choice	yes	available, up to user's choice	yes	-
	UAA	yes	yes	yes	yes	yes	NA	-

DOWL Alaska proposes a system where the water and wastewater holding tanks are located in a small vestibule attached to the house to minimize space requirements in the home and avoid the use of expensive heat trace to a separate holding tank outside the home. The tanks are upright and the water levels are visible. DOWL presented 4 variations of one system for different village scenarios. Key differences between the variations relate to treated water availability and graywater disposal alternatives. The *Summary Table of Proposed Systems* and the attached drawings include information about DOWL's *Version D* system, where both raw and graywater are treated for use in the home, since this system was developed for a village scenario with no community-provided treated water and optimized recycling. Given the strong end-user preference for rainwater and ice melt in the villages DOWL worked with, all system versions include a point-of-use system that filters rainwater or melted ice through a porous ceramic disk for producing drinking water. This filter unit removes turbidity and bacteria from water to meet primary drinking water quality standards without chemicals.

In *Version D*, raw water and recycled graywater are treated to residential water reuse standards as specified in the National Science Foundation/American National Standards Institute (NSF/ANSI) Standard 350-211. Toilet and kitchen wastewater are stored in a waste holding tank and hauled away by a village service as needed. Graywater from the shower, bathroom sink and washing machine is collected in a small storage tank under the bathroom sink and pumped to a 310-gallon graywater holding tank. A pump transfers graywater from the holding tank through a Granular Activated Carbon (GAC) filter and ultraviolet (UV) treatment process into a treated, non-potable water plumbing system and a 60-gallon hydropneumatic tank that has sufficient capacity to automatically backwash the GAC filter and UV tank on a 10-day cycle.

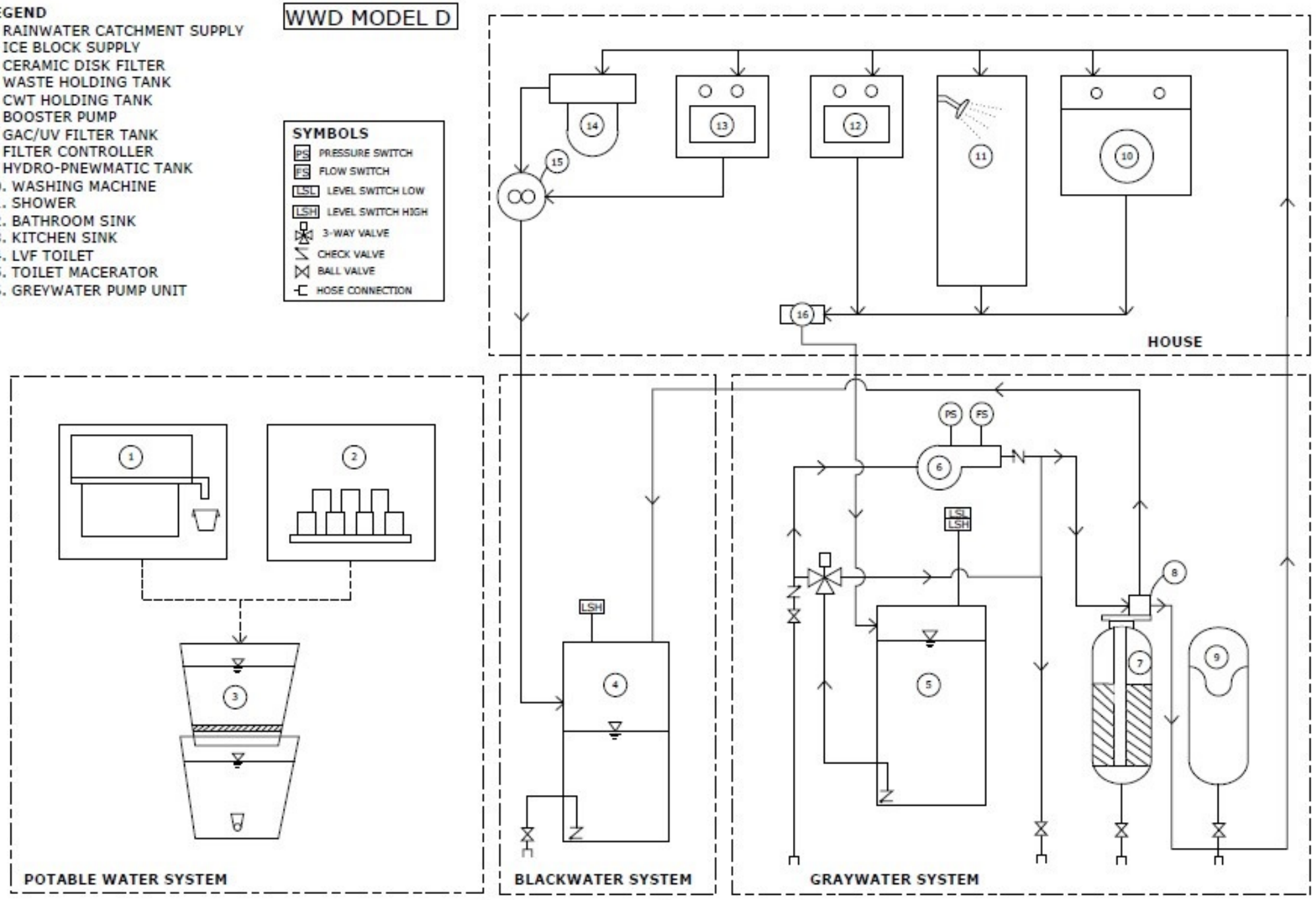
LEGEND

1. RAINWATER CATCHMENT SUPPLY
2. ICE BLOCK SUPPLY
3. CERAMIC DISK FILTER
4. WASTE HOLDING TANK
5. CWT HOLDING TANK
6. BOOSTER PUMP
7. GAC/UV FILTER TANK
8. FILTER CONTROLLER
9. HYDRO-PNEWMATIC TANK
10. WASHING MACHINE
11. SHOWER
12. BATHROOM SINK
13. KITCHEN SINK
14. LVF TOILET
15. TOILET MACERATOR
16. GREYWATER PUMP UNIT

WWD MODEL D

SYMBOLS

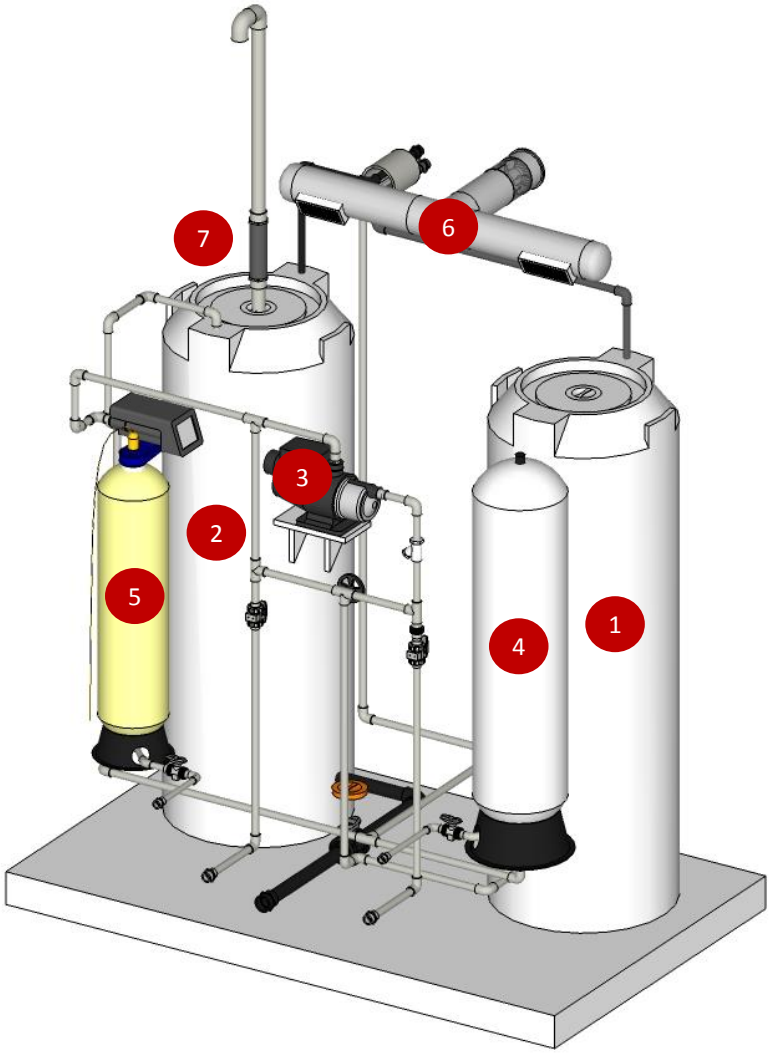
- PS PRESSURE SWITCH
- FS FLOW SWITCH
- LSL LEVEL SWITCH LOW
- LSH LEVEL SWITCH HIGH
- 3-WAY VALVE
- CHECK VALVE
- BALL VALVE
- HOSE CONNECTION



DOWL Alaska: System Schematic of 'Version D'

DOWL Alaska: Version D Front Perspective View (without enclosure)

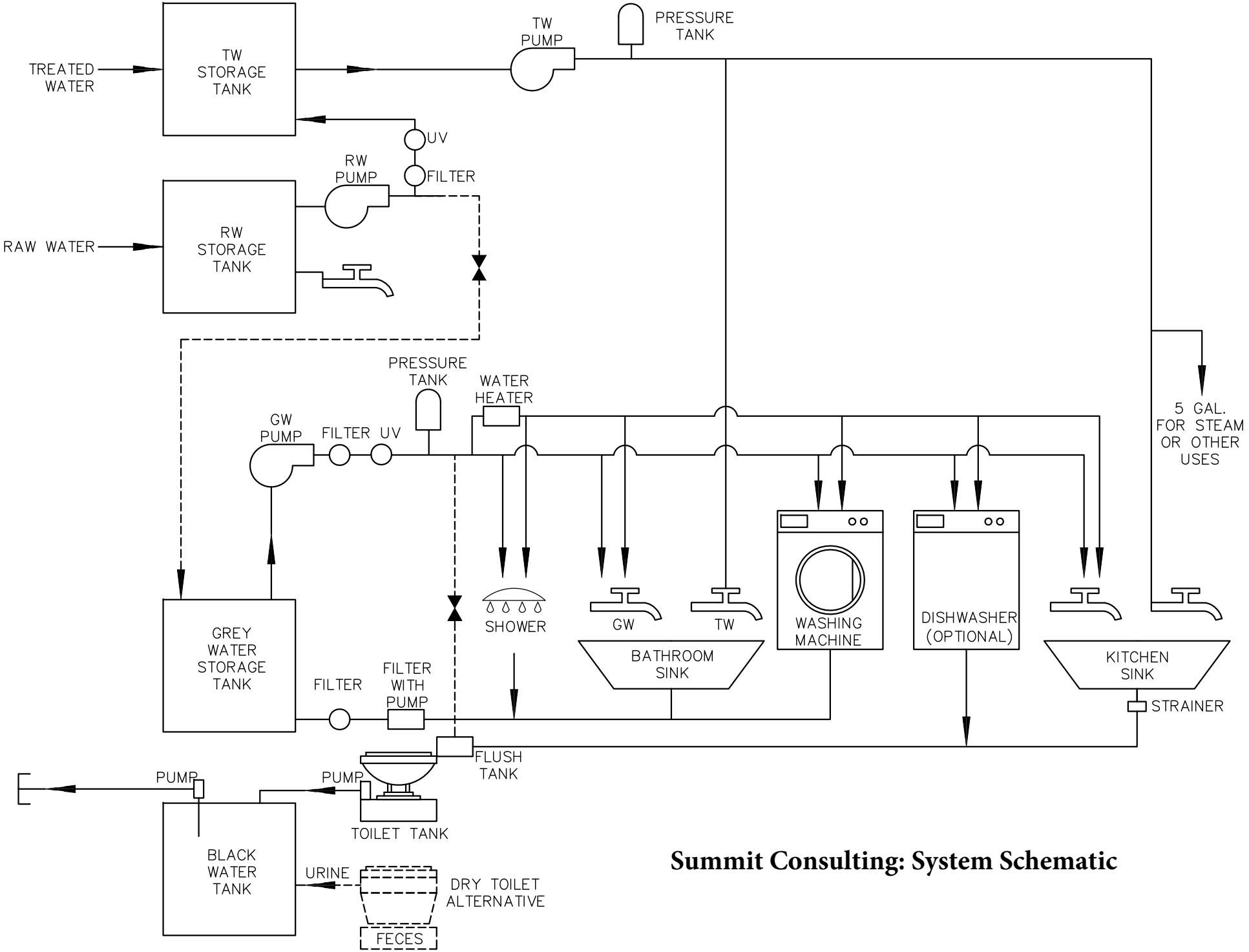
1. 310-Gal Water Holding Tank
2. 310-Gal Waste Holding Tank
3. 5 gpm Booster Pump
4. 60-Gallon Graywater Storage Tank
5. Filter/UV Treatment System
6. 6” Ventilation Duct Pipe
7. Carbon Odor Removal Cartridge



Summit Consulting proposes treatment of raw water by means of a two-stage cartridge filtration process followed by ultraviolet (UV) disinfection. This allows system flexibility to treat a wide range of raw water quality. The system includes three treatment systems, including one for raw water and two for graywater (pre and post graywater storage tank) consisting of 2-stage standard filter housings that can accept a wide variety of readily available filter cartridges. The filter housings can mount on a wall (they protrude about 6 inches) where they can be observed and serviced or replaced as necessary. The raw water tank is plumbed to collect rainwater from the roof. Users also have the option of pumping collected river or rainwater into the tank from the exterior or hauling water or ice into the home and filling a 30-gallon transfer barrel. Insert: The rainwater system can also be plumbed into the graywater system if there is a lack of graywater or an excess of rainwater during a given season.

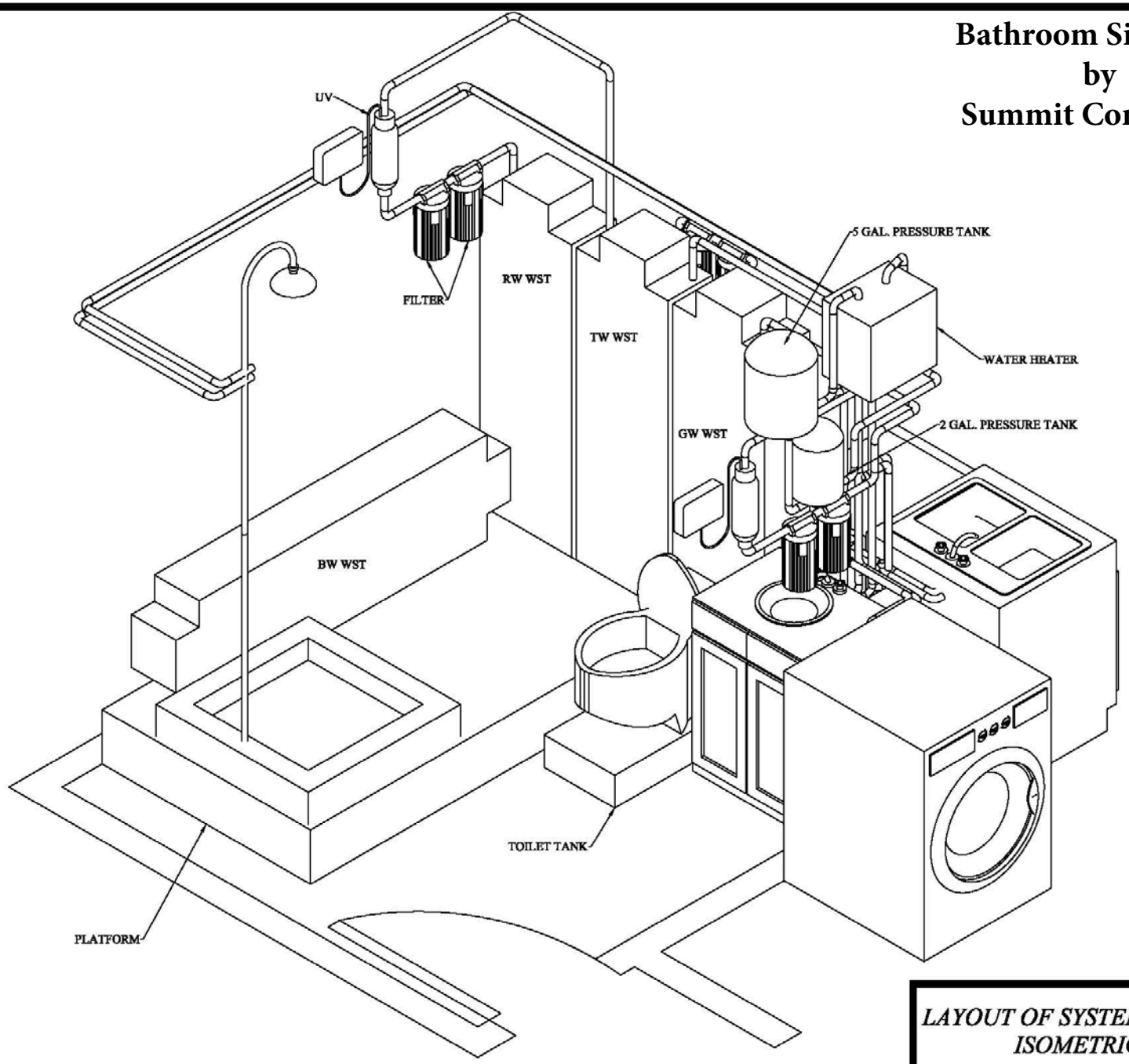
Graywater is treated by a multi-stage process; first, by a primary filter composed of a commercially available primary treatment system with progressively finer filter mats; and next by a secondary cartridge filter before it is sent to a holding tank. Finally, a two-stage filtration process followed by UV disinfection will complete the graywater treatment before being reused. Taps at the kitchen sink and bathroom sink will offer users a choice between treated graywater and treated drinking water. Summit proposes to include a dishwasher for households that express interest and have adequate space. The dishwasher, plumbed parallel to the kitchen sink, will reuse treated graywater and its wastewater will flow to the toilet flush tank.

After passing through a strainer/grease trap, kitchen sink wastewater will flow to a 7.5 gallon toilet flush tank that can also be filled directly from the treated graywater supply line. Summit opted not to propose black water treatment, arguing that fine grained soils, frozen ground and the regulatory environment make such an option problematic for widespread use. Black water that is collected in a holding tank is hauled away by a village service.



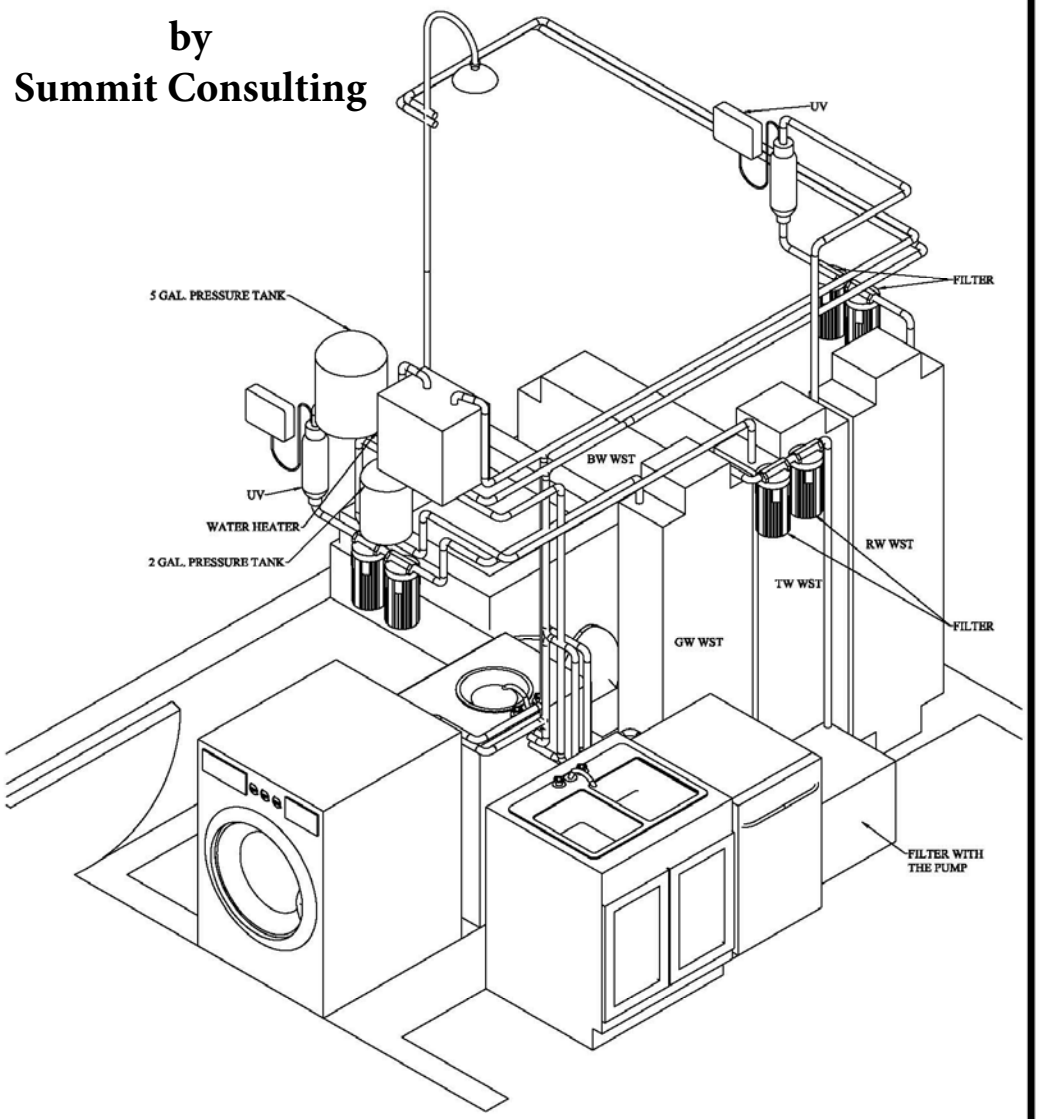
Summit Consulting: System Schematic

Bathroom Side View
by
Summit Consulting



LAYOUT OF SYSTEM COMPONENTS
ISOMETRIC VIEW 1

Kitchen Side View
by
Summit Consulting



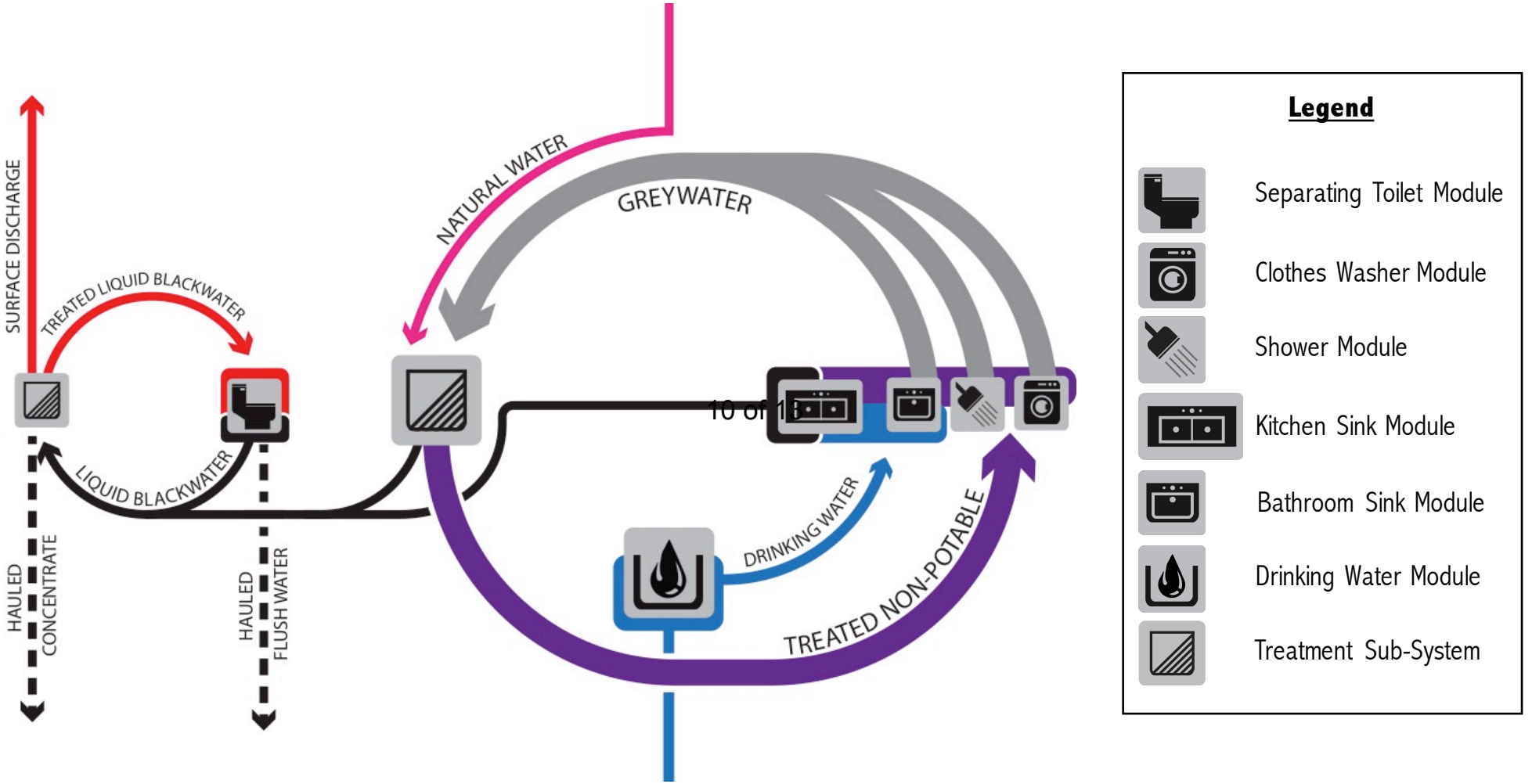
LAYOUT OF SYSTEM COMPONENTS
ISOMETRIC VIEW 2

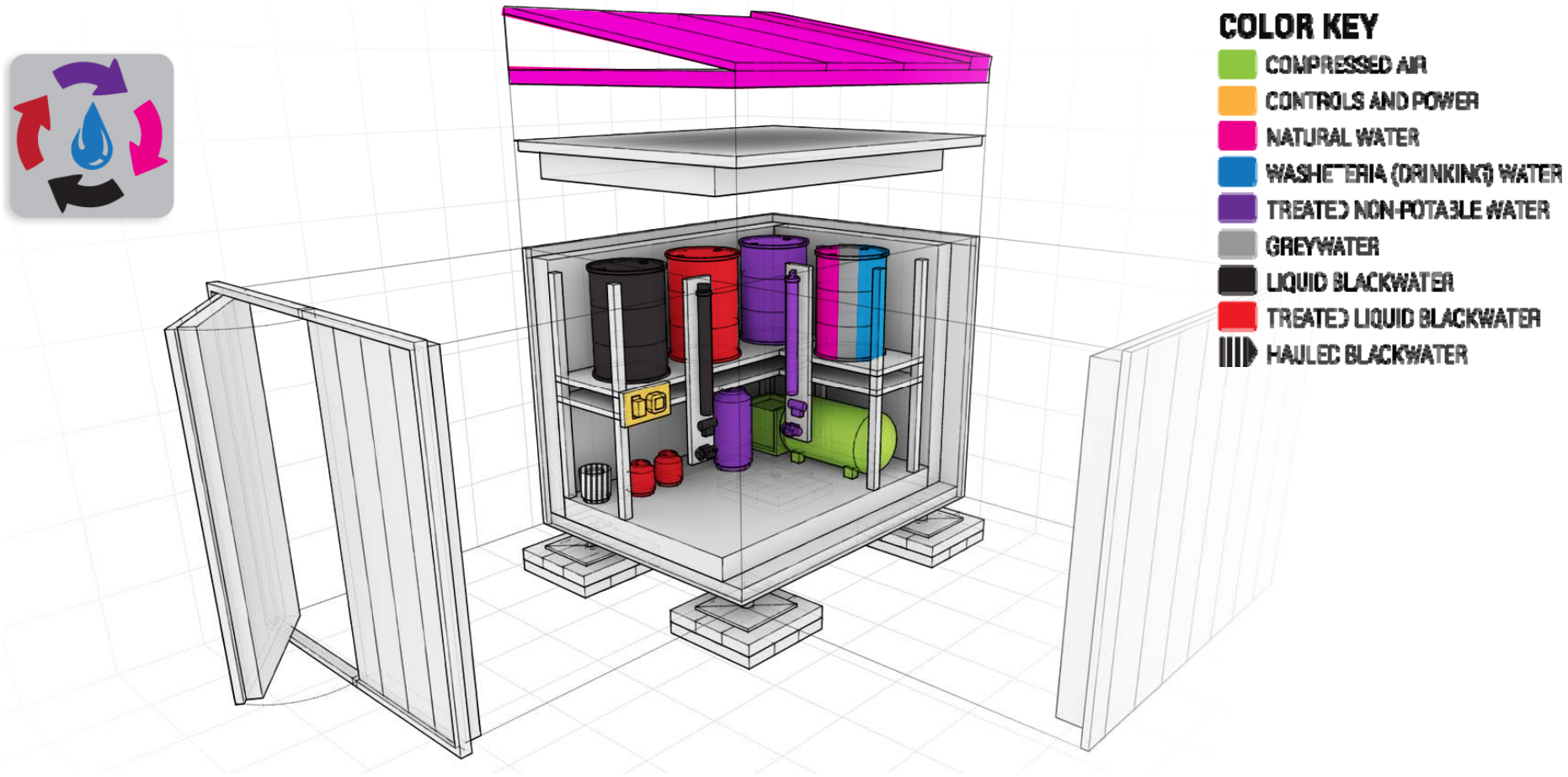
The **University of Alaska Anchorage (UAA)** proposes to recycle both greywater and some blackwater, as well as the use of a modular approach that will allow homeowners to select in-home components that fit their lifestyles and space available at home. The Overview of Proposed Systems table describes UAA's system in its entirety, including 6 in-home modules (Bathroom Sink, Shower, Laundry, Kitchen Sink, Toilet and Drinking Water) and one external module containing treatment equipment located outside the home (Core Module).

UAA's proposed system utilizes a low pressure compressed air system to move water and wastewater into and out of the home. A treatment system that combines coarse filtration, membrane filtration operated in batch concentrating mode, and ultraviolet (UV) disinfection treats water from the greywater collection system to a quality suitable for non-potable use. The liquid black water treatment system treats liquid wastewater from the kitchen sink and toilet to a quality suitable for toilet flushing and on-site surface discharge. All treated waters (greywater and blackwater) are expected to meet drinking water standards. The residual concentrate will automatically discharge to a 5-gallon collection vessel to be hauled away by a village service. The systems for treating greywater and liquid blackwater both use the same process (coarse filtration, membrane filtration and UV disinfection). However, the type of membrane varies by treatment type. A reverse osmosis membrane is used when treating liquid black water and a nanofiltration membrane is used for treating graywater.

UAA estimates that the graywater treatment system will take about 2 hours per day to produce the total daily non-potable water demand, while the treatment process for liquid black water will take 30 minutes per day.

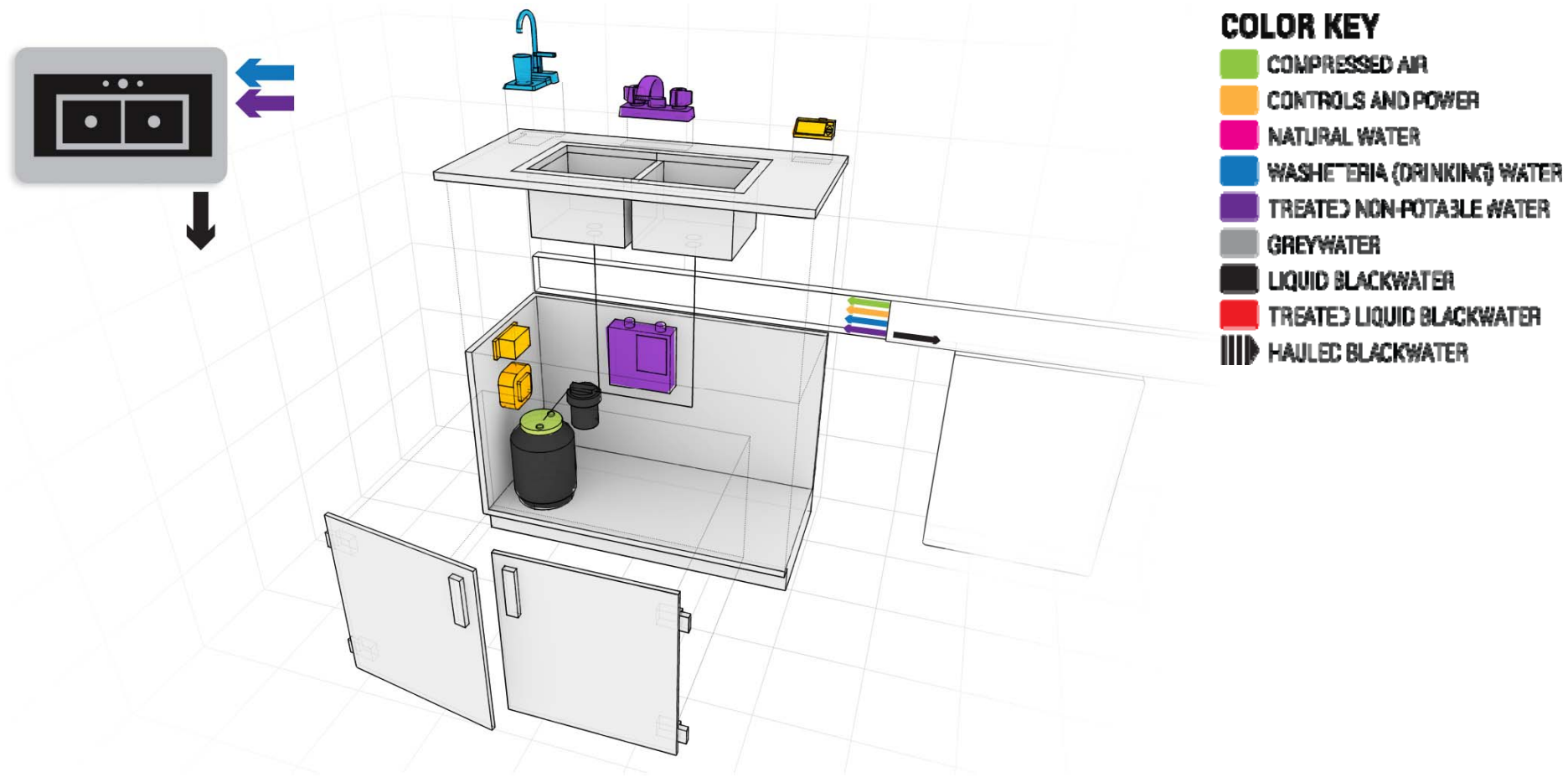
Instead of retaining intellectual property rights, UAA and collaborators are proposing to use an open-source, free-licensing approach for the development of their proposed system in collaboration with other relevant stakeholders.


SURFACE DISCHARGE
TREATED LIQUID BLACKWATER
NATURAL WATER
GREYWATER
LIQUID BLACKWATER
HAULED CONCENTRATE
HAULED FLUSH WATER
DRINKING WATER
TREATED NON-POTABLE
Legend
Separating Toilet Module
Clothes Washer Module
Shower Module
Kitchen Sink Module
Bathroom Sink Module
Drinking Water Module
Treatment Sub-System



Sketch – Core Module

by University of Alaska Anchorage



Sketch – Kitchen Sink Module

by University of Alaska Anchorage