Fletcher C reek Improvement District – Treatment Committee – Purpose Objectives and Tasks

In January of 2022 the Fletcher Creek Improvement District (FCID) established a Treatment Committee to develop the options for water treatment, or not. The treatment committee was formed with:

- Trustee Neil Kelly as the Chairman and board liason,
- Trustee Peter Sonnenberg,
- Trustee Laurie Rutherford,
- Community member Brad Hartland,
- Consultant Don Scarlett, and
- Former Trustee and community member Robert Cunliffe.

It was originally intended to conduct the work in phases using sub-committees to:

1) Identify the options to be studied.
2) Develop the hard cost issues for each of the options, and
3) Develop the soft qualitative issues for each of the options.

Tentatively seven options have been identified:

1) Maintain current operation with no treatment by the FCID. Individual users make their own decision on processing their water to suit potability standards.
2) Point of Use: Installation of a small filter and ultraviolet disinfection cell "under the sink". (Without new evidence to the contrary, this treatment option cannot be considered to deliver potable water without placing a water heater at the point of use allowing both hot and cold faucets at the sink to be treated.)
3) Point of Entry: Installation of filters and ultraviolet disinfection cell to treat all water for domestic use in a residence. Point of Entry has been developed in enough detail to enable cost estimating.

   The Piping and Instrumentation Diagram, and the piping isometric, are attached as Figures 3A1, 3A2, 3B1, and 3B2. The Material Take- Off is appended as Table 3A and 3B with tradesman labor estimates to render the installed cost at slightly less than $2,000 plus taxes for a "more than meets requirements" option.

4/5/6) Central Treating Options: Installation of process building blocks at the current intake to yield three options for central treating, Case 4, 5, and 6. Process building blocks, pumping, filtration, ultraviolet disinfection, and chlorination are developed as separate

building blocks so that they can be combined to render Cases 4, with pumping, filtration, and ultraviolet disinfection; Case 5, with pumping, filtration, ultraviolet disinfection and chlorination; and Case 6 with chlorination only.

The building blocks are illustrated as figures A, B, C and D. The cases are illustrated as Figures 4, 5, and 6 showing which building blocks are paired and how they fit together to make the relevant case.

Major components making up each case are to be presented as Table 4, Table 5 and Table 6 which are under development.

7) Pipeline and purchased water: Pipeline from the Village of Kaslo or Woodbury tying into the existing distribution system using the existing intake tankage at the existing intake acting like a water tower.

The design basis for Cases 4 through 7 is attached here as Appendix A: Central Treating Design Basis.

The sizing of the lift pump(s), and generator for central treating options 4, 5 and 6 is presented in Appendix B: Pump, Generator and Building Heater Sizing.

The critical path item in the development of the central treating cases is the completion of the Pilot Study. Site II of the Pilot Study was commissioned 2022-01-22. Its goal is proving the capacity and screen size of filter bodies for Case 3. Site I has been in operation for several years and has proven the effectiveness of 40 mJ/cm^2 ultraviolet light disinfection of Fletcher Creek water. It also runs larger filters than Site II. The first set of filter media in Site I processed water for domestic use and irrigation. It therefore provides data for a residence's domestic and irrigation use combined which applies to central treating but not for Point of Entry with irrigation taken as a slipstream before treatment. Sites I and II provide data on two distinctly different operations. An interim report on the performance of Site I Pilot Study was issued in the fall of 2021 at the end of service fo the first filter set. That interim report is attached as Appendix C.

List of Figures:

1) There is no Figure 1. This figure has been intentionally omitted.
2) PID for Point of Use.

3A1) PID for Point of Entry – More Than "Meets Requirements"
3A2) Piping Isometric for Point of Entry _ "Meets Requirements"
3B1) PID for Point of Entry

List of Tables:

Appendices:

A) Central Water Treatment Facility - Design Basis
B) Pump, Generator and Building Heater Sizing
C) Interim Report – Pilot Study

Table 8: Qualitative Issues

CASE >>	1	2	3	4	5	6	7
	Maintain	POU	POE	CWT with filters and UVT	CWT with filters, UVT and Cl	CWT with Cl only	Purchased Water by Pipeline
can eliminate the Boil Water Notice	NO	NO	NO	NO	YES	NO	YES
CAN BE INSURED	NO	NO	NO	NO	NO	NO	NO
EFFECTIVENESS TO ALL POINTS OF USE	NO	NO	YES	YES	YES	YES	YES
FCID operating cost per connection per year	$300-$400/yr	$300-$400/yr	$300-$400/yr	$910/yr (Note 1)	$965/yr (Note 1)	$780/yr (Note 1)	VERY HIGH TBD
Financing cost per connection (Note 2)	$0/yr	$0/yr	$0/yr	$380/yr	$440/yr	$140/yr	VERY HIGH TBD
Homeowner operating cost	$100/yr (electricity to boil)	$50/yr	$200/yr	$0/yr	$0/yr	$0/yr	$0/yr
Total Combined Operating Cost per connnection	$470/yr	$420/yr	$570/yr	$1290/yr	$1405/yr	$920/yr (Note 3)	VERY HIGH TBD
confined to a single source	NO	NO	NO	YES	YES	YES	YES
EASE OF USE	NEED TO BOIL WATER	NEED TO BOIL WATER	OK TO DRINK	OK TO DRINK	OK TO DRINK	OK TO DRINK	OK TO DRINK

Notes:

1) Annual operating cost as $40k for opertor, $5k for filter media, $5k for UV bulbs, $3k for Chlorine sum distributed to 55 users
2) Financing cost calculated with 15 yr amortization at 3.42% pa (RBC Mortgage Calculator 2022-02-24) shared by 55 users
3) For the cost of a single charcoal filter ($200) and annual operating cost of $140 the Cl could be removed at the entry point to the residence.
4) Confined to a single source means that the treatment option would require a larger capital investment if Fletcher Creek was not the water source. Central Treating would require more construction dollars than POU, or POE. The cost to change water source for the "Maintain" option is common to all cases.

Table 9: Central Water Treating Class 5[1] Capital Cost Estimate

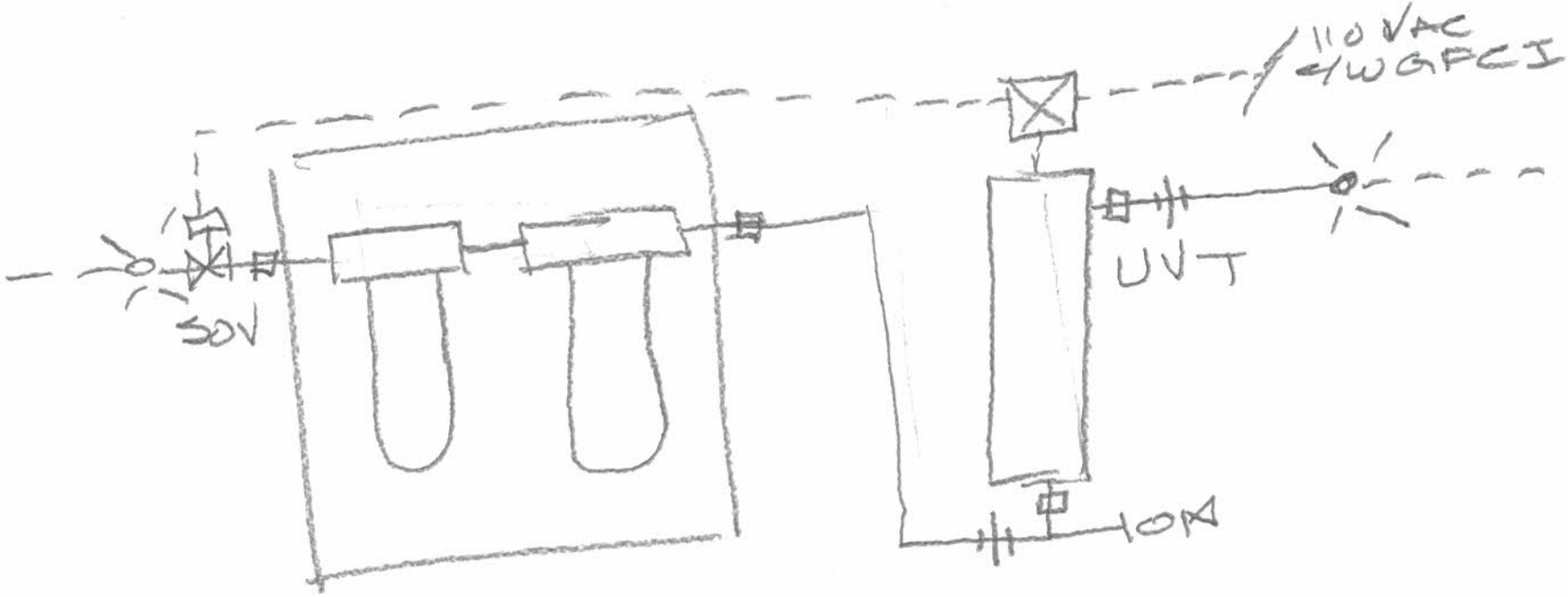
unit operation	unit cost x $1000	case4	case 5	case 6
Building Renovation	5	✓	✓	✓
Utility Power Supply	20	✓	✓	✓
Lift Pump	25	✓	✓	✓
Sediment Filtration	125	✓	✓	
Ultraviolet Disinfection	75	✓	✓	
Chlorine Disinfection	40		✓	✓
TOTAL CAPITAL COST x $1000		250	290	90

Notes:

1) Class 5 cost estimate is +/- 50%

by NK 2022-02-28

CASE 2: POINT OF USE (UNDER SINK)



PENTEK BFS-201
OR SIMILAR

FIGURE 2: Case 2

FIGURE 3A1 - CASE 3 - POINT OF ENTRY

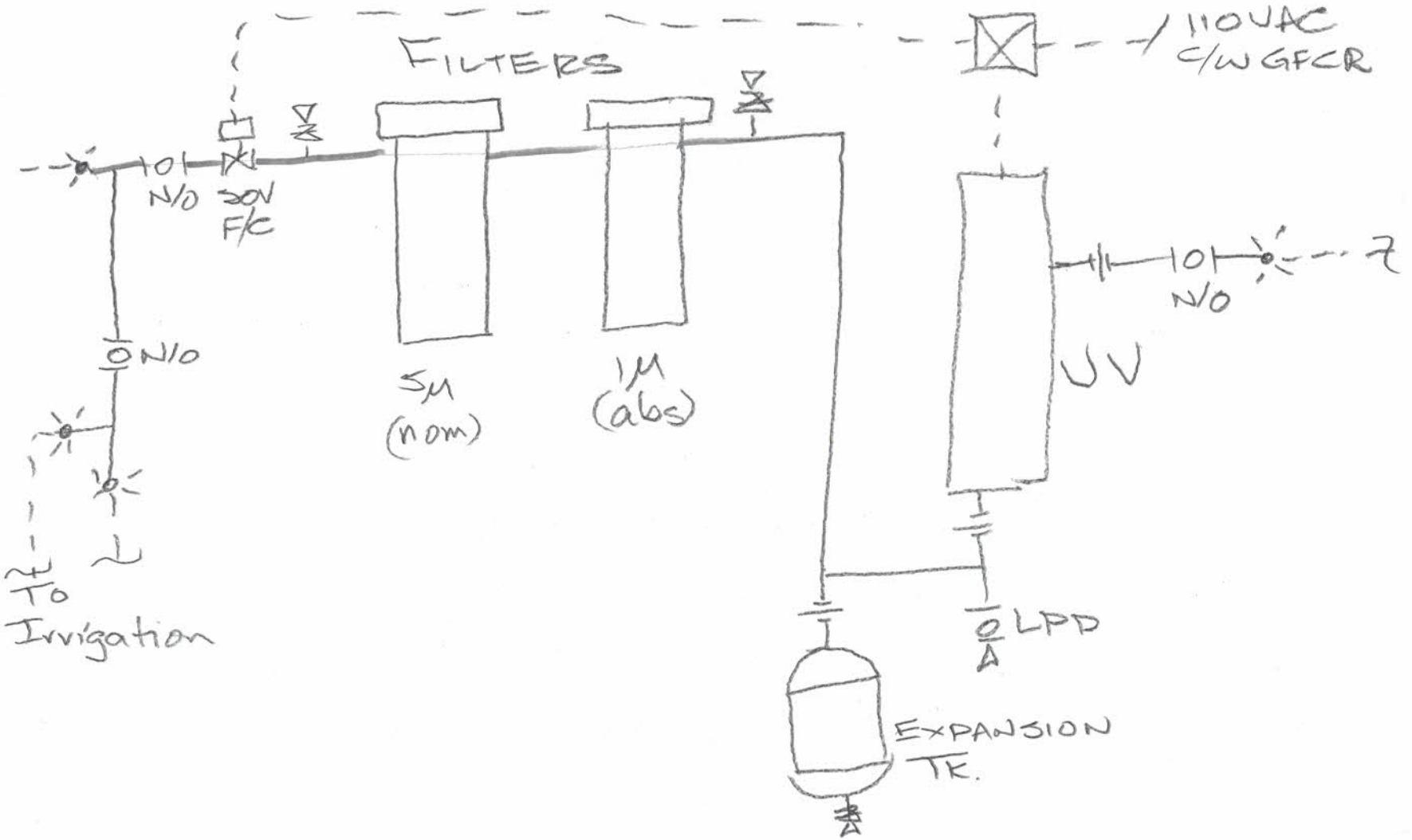


Figure 3A2: Piping Isometric

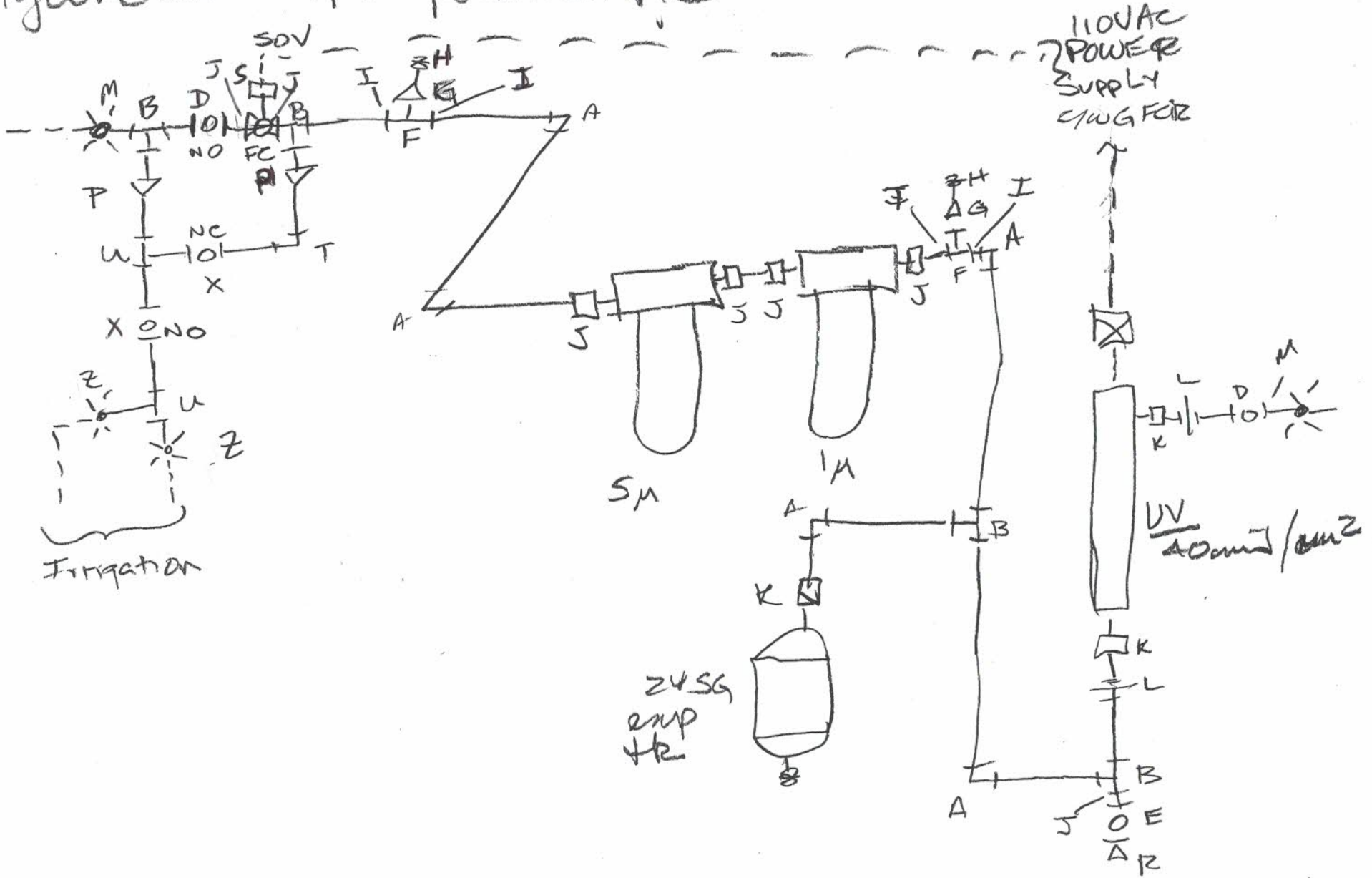


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Table 3A : MoreThan Minimum Point of Entry Material and Labor Take-Off

label	qty	description	aquadynamics p/n	sharkbite p/n	unit price	subtotal		
A	5	3/4 PEX ELL		UC256LFCA	3.62	18.10		
B	4	3/4 PEX TEE		UC370LFCA	3.93	15.72		
C		3/4 PEX PLUG		UC518LFCA	2.70	0.00		
D	2	3/4 pex ball valve	1197-394		13.50	27.00		
E	1	3/4 ball valve tbe	1107-824		16.30	16.30		
F	2	3/4 x 3/4 x 3/4 cxcxc tee	9006-434		2.73	5.46		
G	2	3/4c x 1/4 fnpt	9002-031		3.14	6.28		
H	2	1/4 snifton valve	ACE KASLO		7.49	14.98		
I	4	3/4 male sweat by 3/4 pex		UC608LFCA	4.27	17.08		
J	7	3/4 pex x 3/4 MNPT		UC134LFCA	5.10	35.70		
K	3	3/4 pex x 3/4 FNPT		UC088LFCA	4.49	13.47		
L	2	3/4 union pex (aquadynamics 9008-434)+2(UC608LFCA)			14.86	29.72		
M	2	3/4 pex cplg		UC016LFCA	2.80	5.60		
N	36	3/4 pex rings	package of 25	23103CP25	13.10	26.20		
P	2	3/4 x 1/2 pex		UC058LFCA	2.41	4.82		
Q	10	3/4 pex tbg HOME HARDWARE SKU: 3298-069	20 ft length		21.99	21.99		
R	1	3/4 mnpt plug SIOUX CHIEF 931-50301			5.31	5.31		
S	1	3/4 sov fc Electric Solenoid Valves 3/4 brass 110 VAC		UC000LFCA	65.94	65.94		
T	1	1/2 pex ell		UC248LFCA	2.58	2.58		
U	2	1/2 pex tee		UC362LFCA	3.37	6.74		
V		1/2 pex plug		UC514LFCA	1.89	0.00		
X	2	1/2 pex ball valve	1197-393		11.76	23.52		
Y	10	1/2 pex tbg HOME HARDWARE SKU: 3298-078			11.99	11.99		
Z	2	1/2 pex cplg		UC008LFCA	1.68	3.36		
AA	12	1/2 pex rings	package of 25	23102CP25CA	8.77	8.77		
					Fittings Total=	386.63		
		major components & electrical						
B1	1	2 USG thermal expansion Tank Easton	HD sku: 1000850984		37.98	37.98		
B2	2	Rainfresh FC005 filter housings c/w 5μ cartridge	ACE Kaslo		30.99	61.98		
B3	1	Fresh Water Systems 1m absolute cartridge			25	25	this item priced at 9.99 on US website	
B4	1	Rainfresh R830	ACE Kaslo		419.99	419.99		
B5	1	GFCR	HD sku: 1000660807		21.48	21.48		
B6	1	25 ft extension cord	HD sku: 1001054608		11.94	11.94		
		shop supplies				50.00		
					Subtotal All Hardware=	1015.00		
	8	plumber labor quote of 8 hours			80	640		
	1.5	electrician labor estimate of 1.5 hours			80	120		
				GRAND TOTAL INSTALLED COST=		2161.63	PLUS TAXES	

FIGURE 3B1 - CASE 3B - MEETS REQUIREMENTS POE

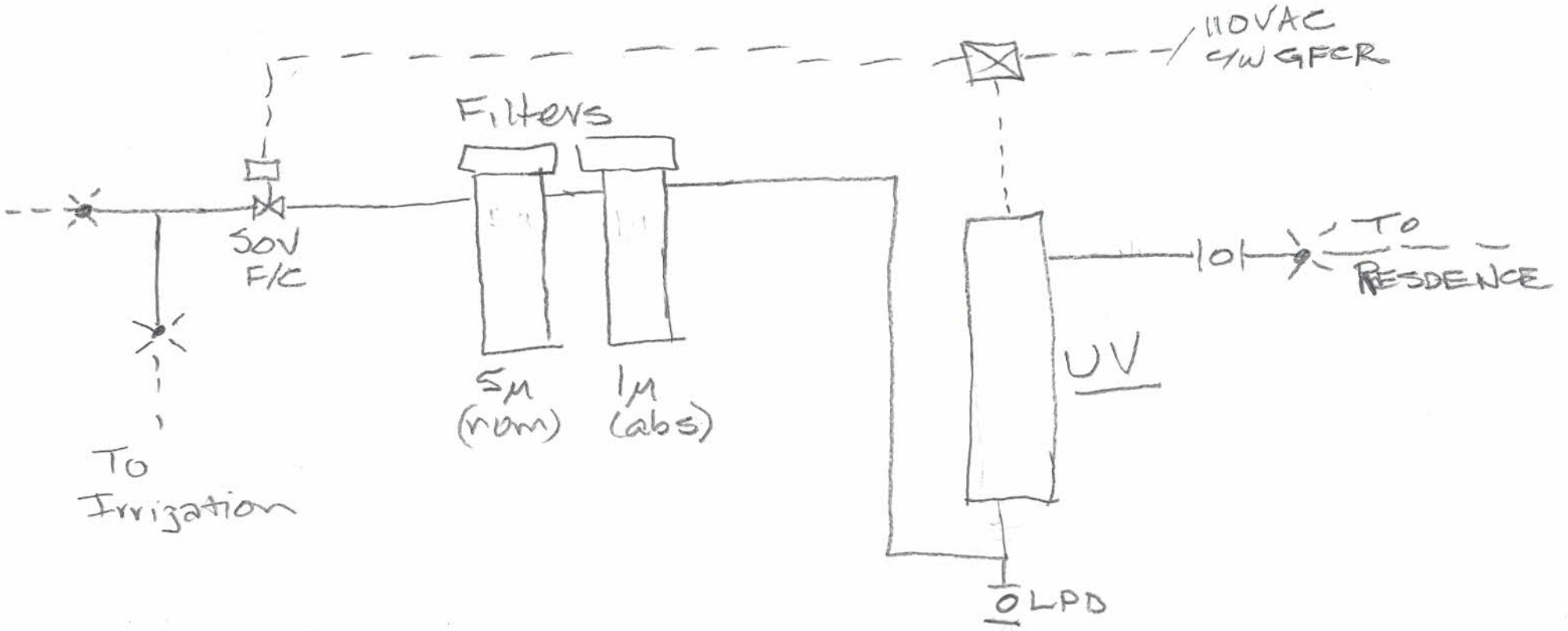

Table 3B : Meets Requirements Point of Entry Material and Labor Take-Off

	label	qty	description	aquadynamics p	sharkbite p/n	unit price	subtotal	
	A	5	3/4 PEX ELL		UC256LFCA	3.62	18.10	
	B	3	3/4 PEX TEE		UC370LFCA	3.93	11.79	
	C		3/4 PEX PLUG		UC518LFCA	2.70	0.00	
	D	2	3/4 pex ball valve	1197-394		13.50	27.00	
	E		3/4 ball valve tbe	1107-824		16.30	0.00	
	F		3/4 x 3/4 x 3/4 cxcxc tee	9006-434		2.73	0.00	
	G		3/4c x 1/4 fnpt	9002-031		3.14	0.00	
	H		1/4 snifton valve	ACE KASLO		7.49	0.00	
	I		3/4 male sweat by 3/4 pex		UC608LFCA	4.27	0.00	
	J	6	3/4 pex x 3/4 MNPT		UC134LFCA	5.10	30.60	
	K	3	3/4 pex x 3/4 FNPT		UC088LFCA	4.49	13.47	
	L		3/4 union pex (aquadynamics 9008-434)+2(UC608LFCA)			14.86	0.00	
	M		3/4 pex cplg		UC016LFCA	2.80	0.00	
	N	31	3/4 pex rings	package of 25	23103CP25	13.10	26.20	
	P	1	3/4 x 1/2 pex		UC058LFCA	2.41	2.41	
	Q	10	3/4 pex tbg HOME HARDWARE SKU: 3298-069	20 ft length		21.99	21.99	
	R		3/4 mnpt plug SIOUX CHIEF 931-50301			5.31	0.00	
	S	1	3/4 sov fc Electric Solenoid Valves 3/4 brass 110 VAC		UC000LFCA	65.94	65.94	
	T		1/2 pex ell		UC248LFCA	2.58	0.00	
	U		1/2 pex tee		UC362LFCA	3.37	0.00	
	V		1/2 pex plug		UC514LFCA	1.89	0.00	
	X		1/2 pex ball valve	1197-393		11.76	0.00	
	Y	10	1/2 pex tbg HOME HARDWARE SKU: 3298-078	20 ft length		11.99	11.99	
	Z	1	1/2 pex cplg		UC008LFCA	1.68	1.68	
	AA	2	1/2 pex rings	package of 25	23102CP25CA	8.77	8.77	
						Fittings Total=	239.94	
			major components & electrical					
	B1	1	2 USG thermal expansion Tank Easton	HD sku: 1000850984		37.98	37.98	
	B2	2	Rainfresh FC005 filter housings c/w 5μ cartridge	ACE Kaslo		30.99	61.98	
	B3	1	Fresh Water Systems 1m absolute cartridge			25	25	
	B4	1	Rainfresh R830	ACE Kaslo		419.99	419.99	
	B5	1	GFCR	HD sku: 1000660807		21.48	21.48	
	B6	1	25 ft extension cord	HD sku: 1001054608		11.94	11.94	
			shop supplies				50.00	
						Subtotal All Hardware=	868.31	
		5	plumber labor quote of 8 hours			80	400	
		1.5	electrician labor estimate of 1.5 hours			80	120	
					GRAND TOTAL INSTALLED COST=		1628.25	PLUS TAXES

Figure 3B2: Piping Isometric

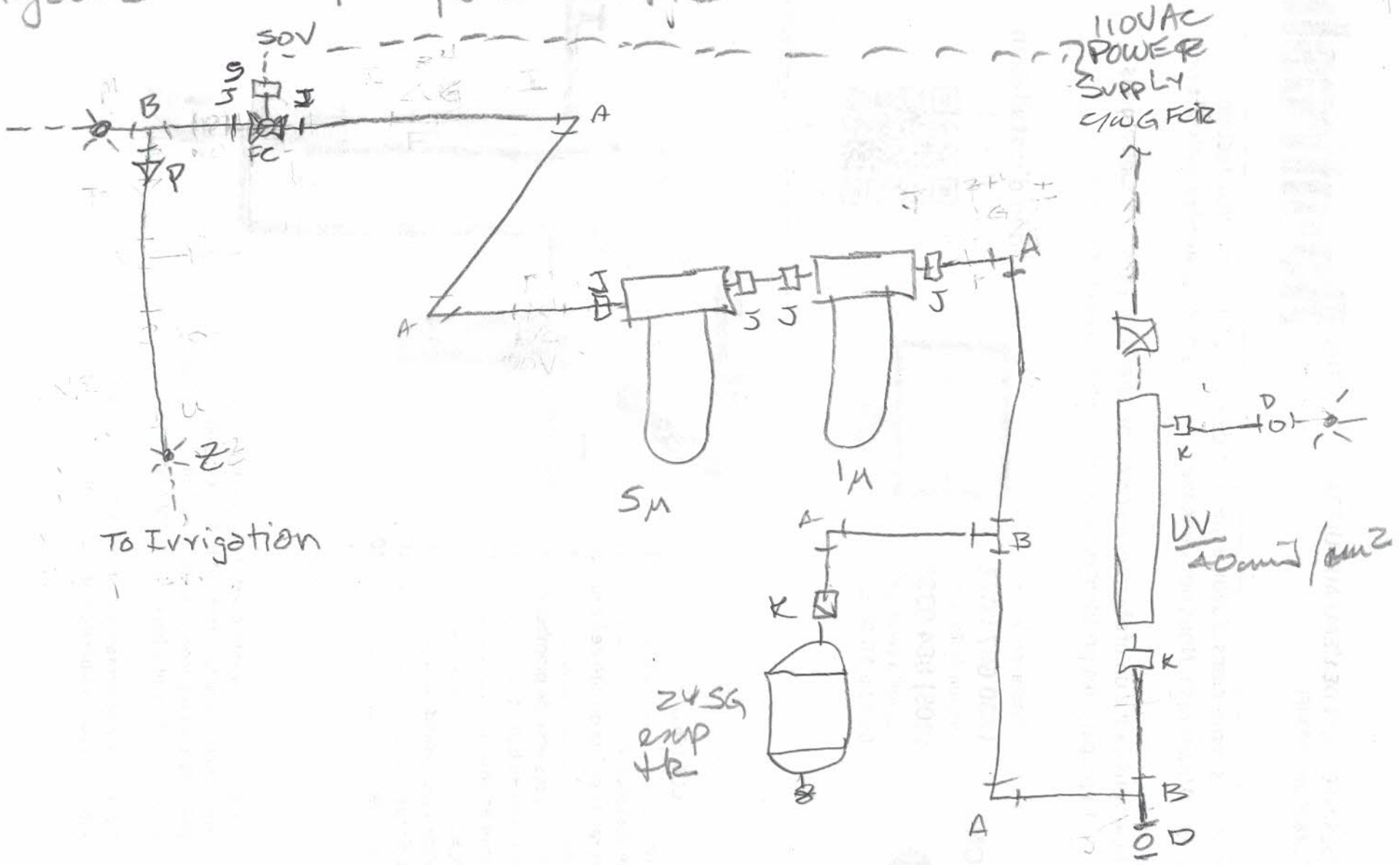

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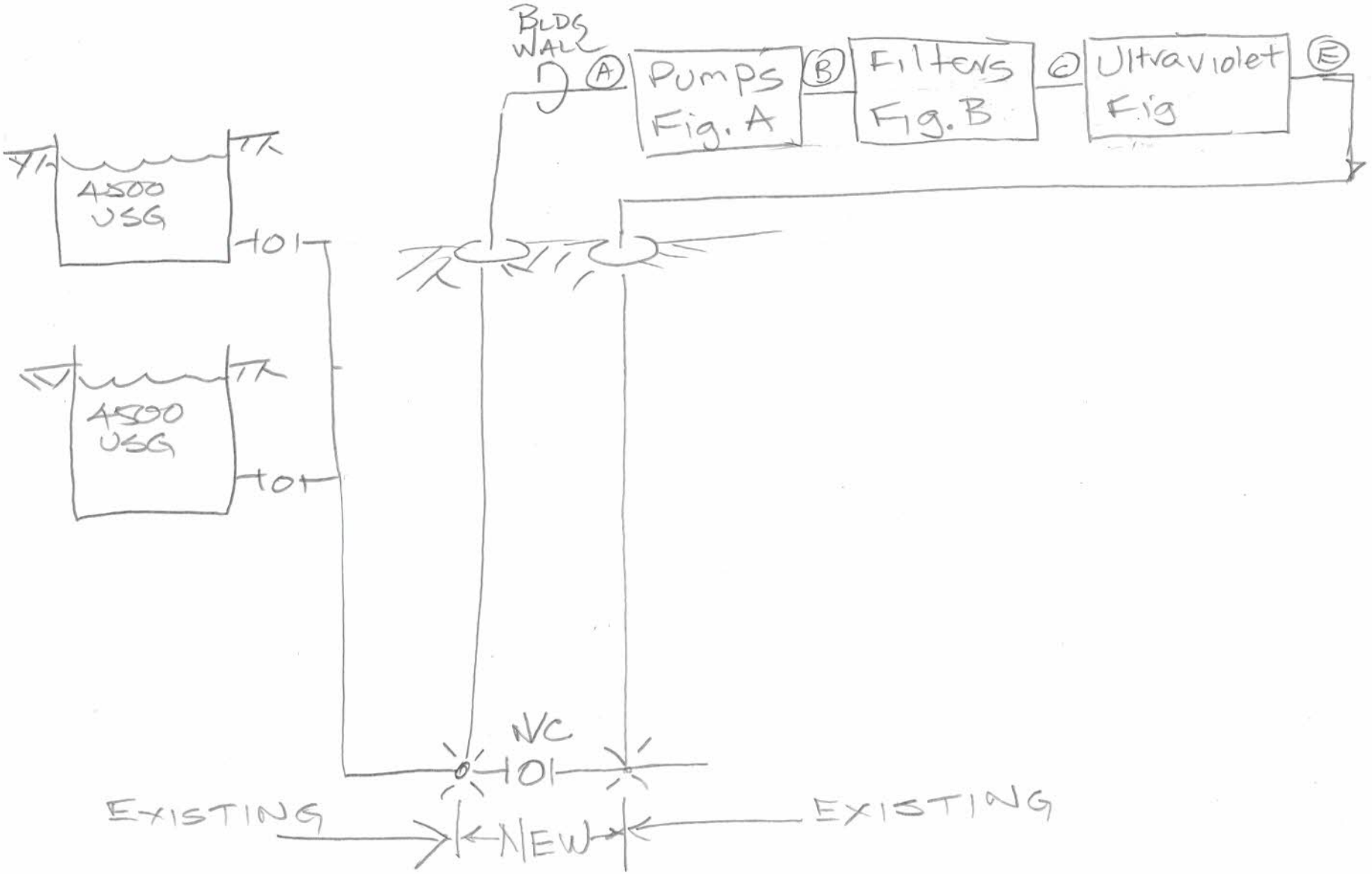
FIGURE 4 – CWT with pump, filter, and Ultraviolet Disinfection



CASE 5: LIFT PUMPS, FILTERS, Ultraviolet & chlorination

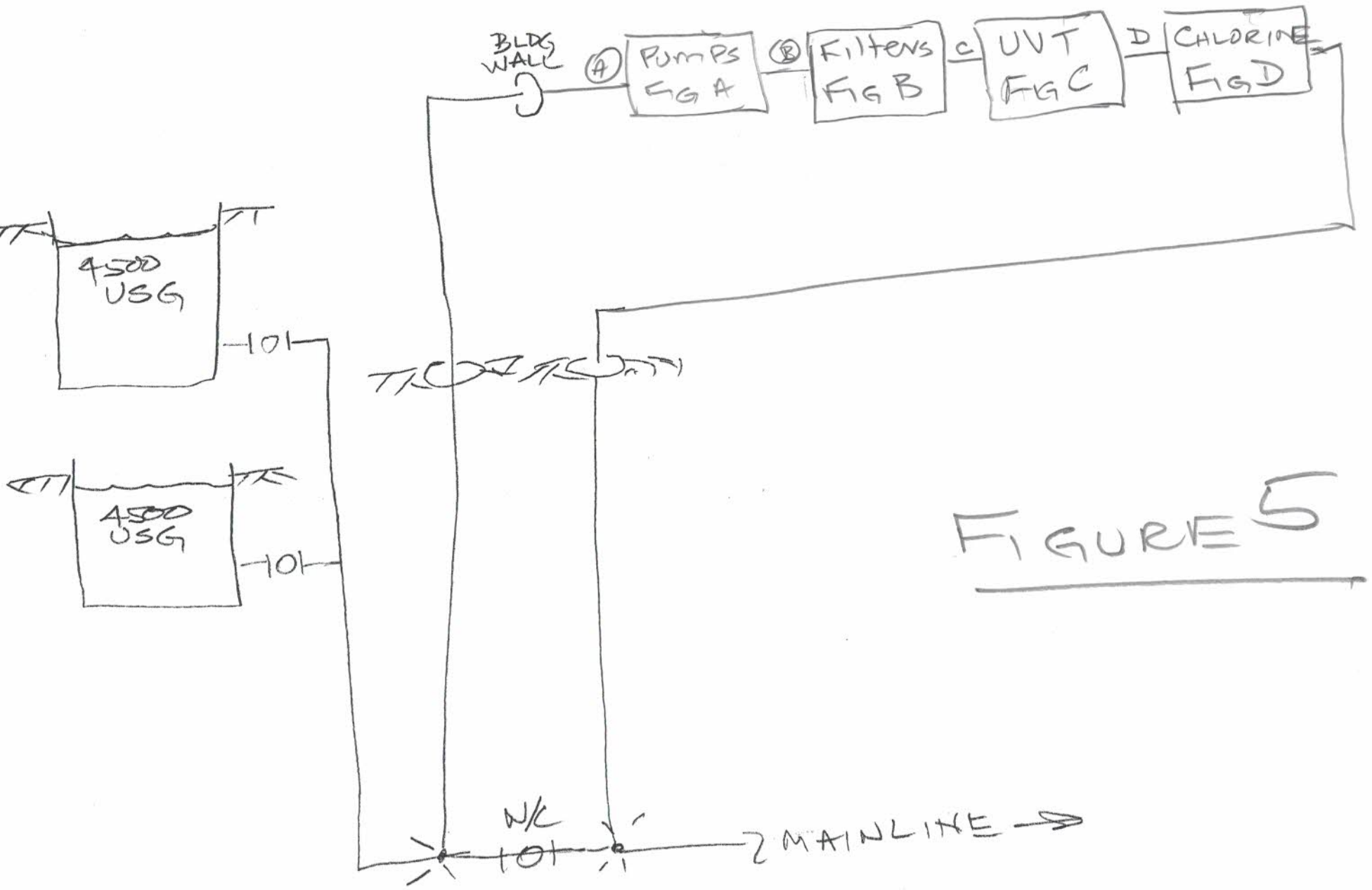


FIGURE 5

CASE 6 : PUMPS & CHLORINATION

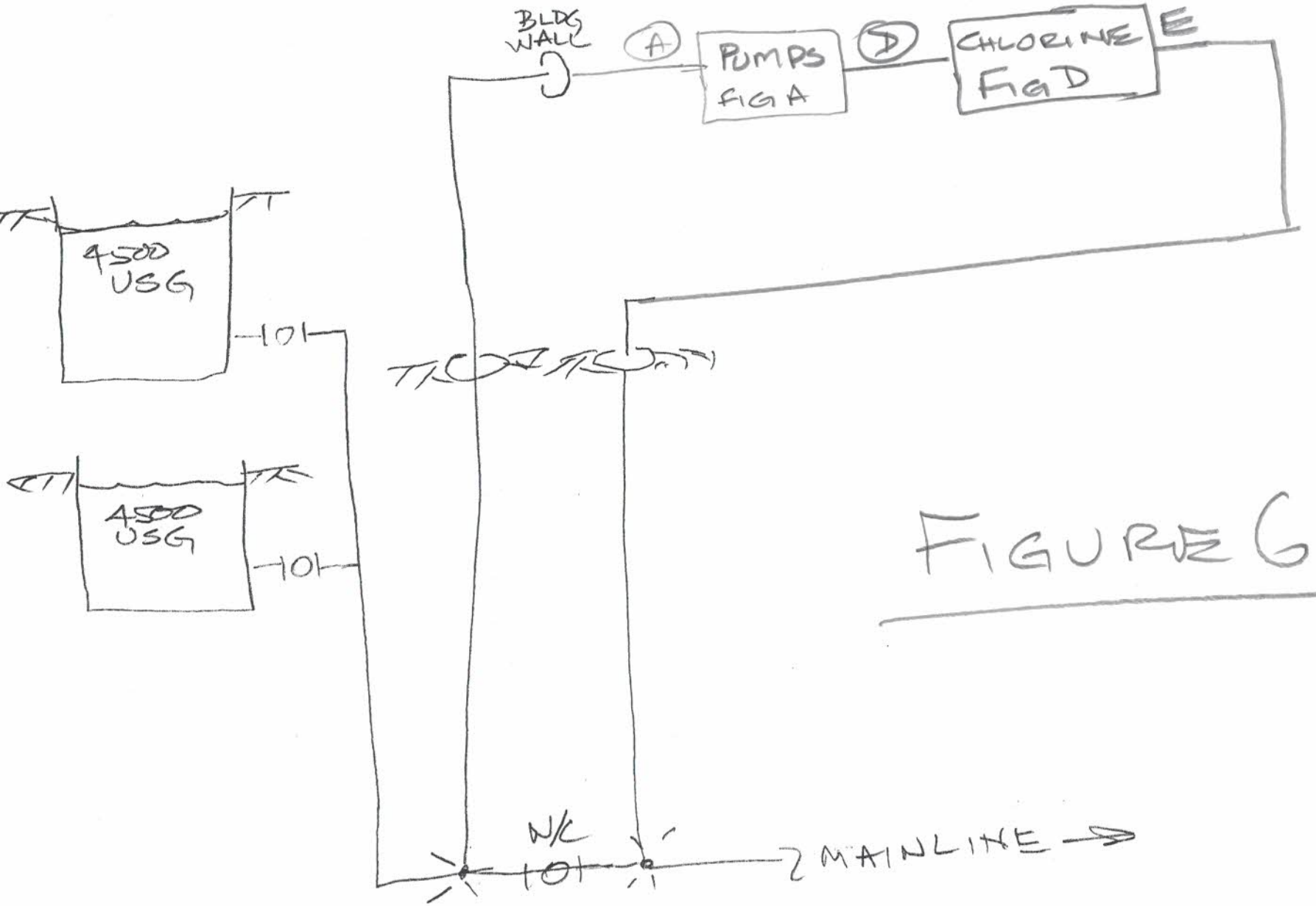
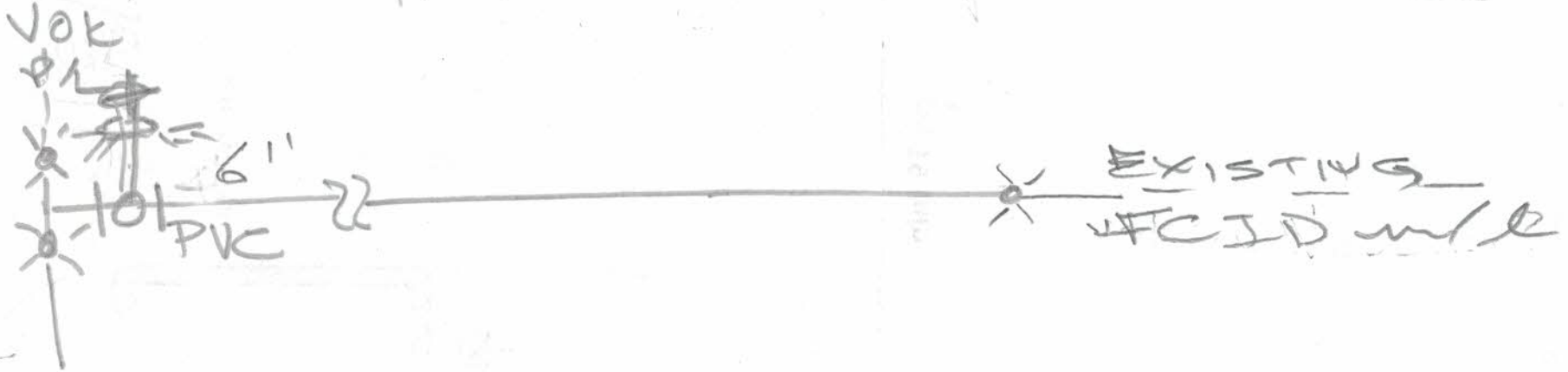


FIGURE 6

FIGURE 7: PURCHASED WATER PIPELINE



- source could be Kaslo or Woodbury
- demolish existing creek works?
- lay 7½ km 4/6 PVC pipeline, (5 km ploughed)
- get Mirror Lake to share cost?

FIGURE 7

4" pipe requires pumping
6" pipe requires No pumping

FIGURE A: LIFT PUMPS

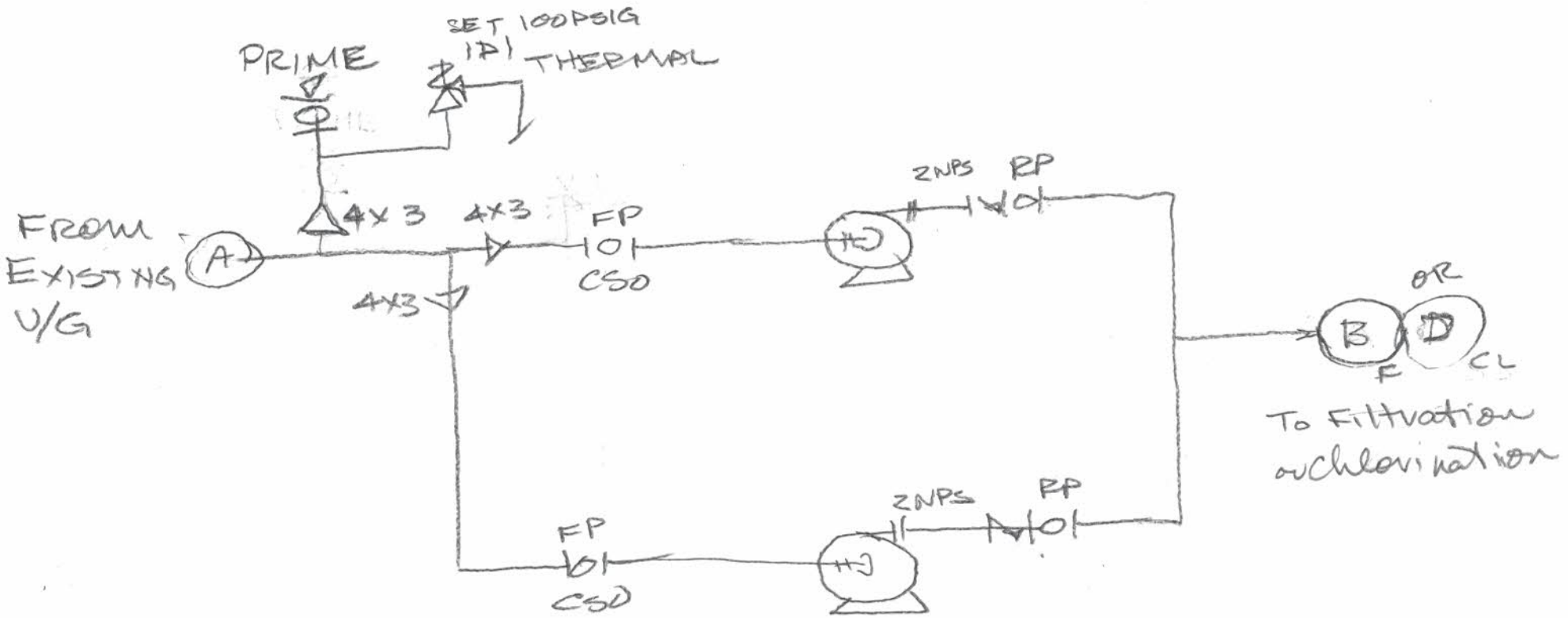


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FIGURE B: FILTRATION

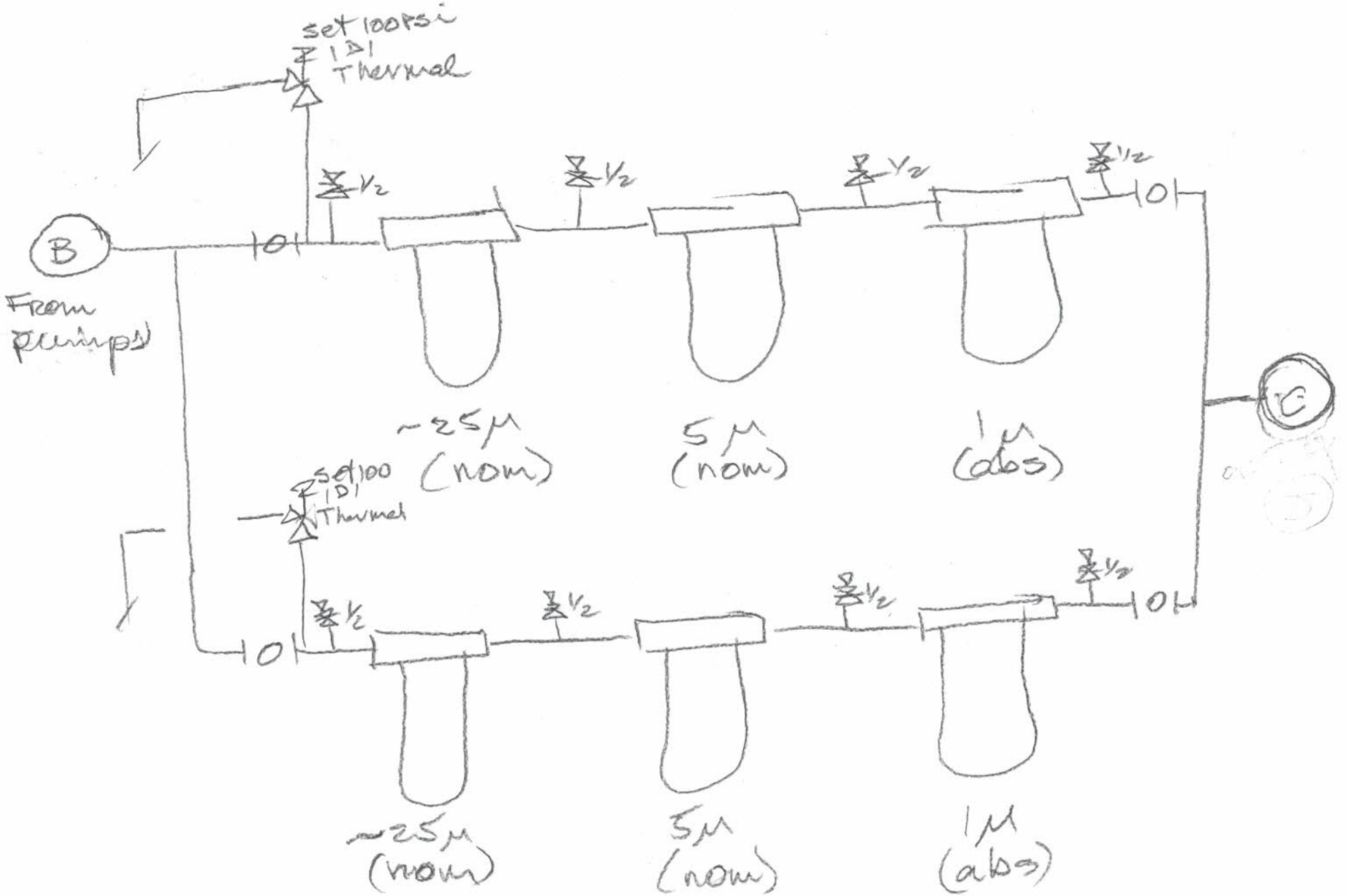


Figure C : Ultraviolet Disinfection

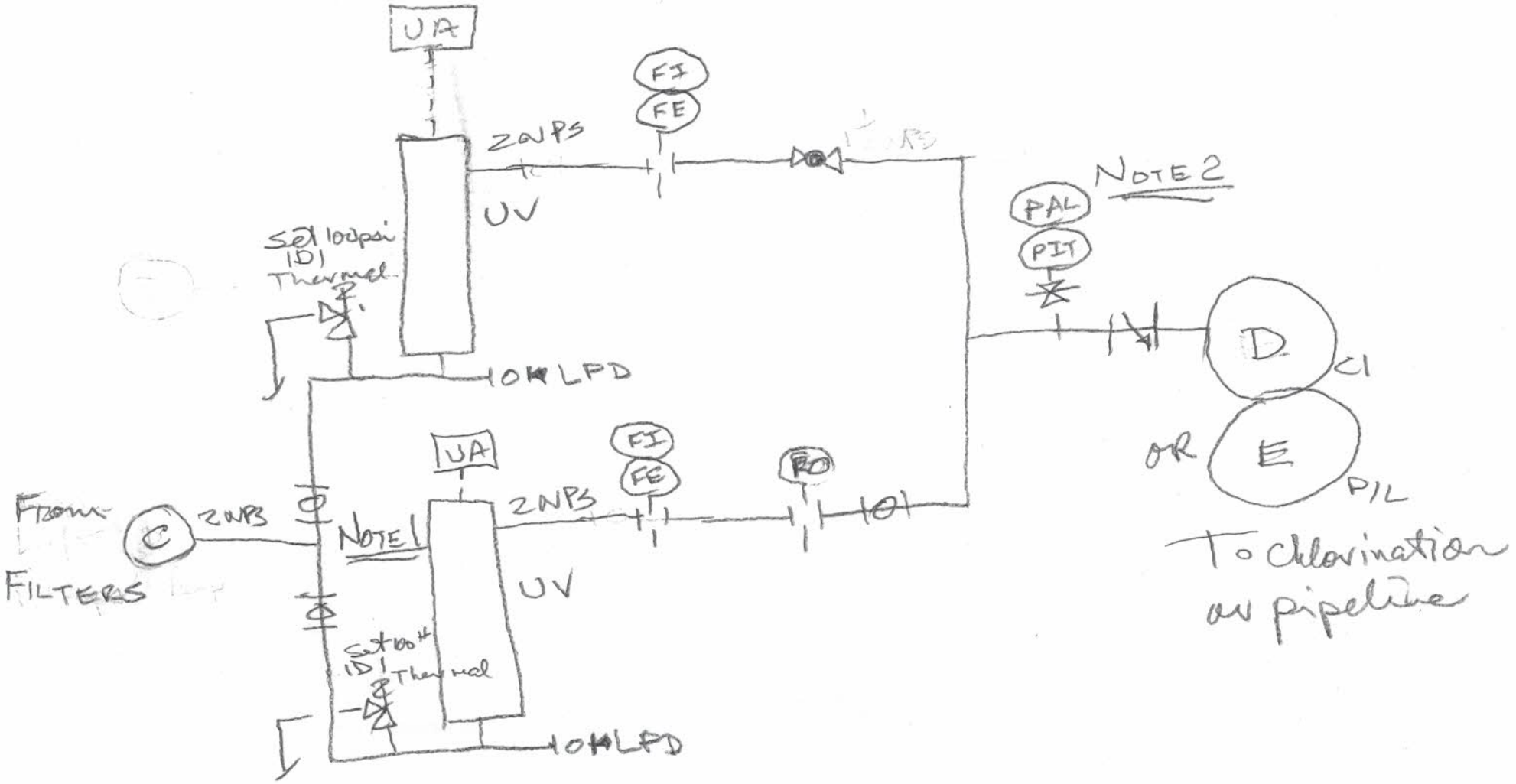
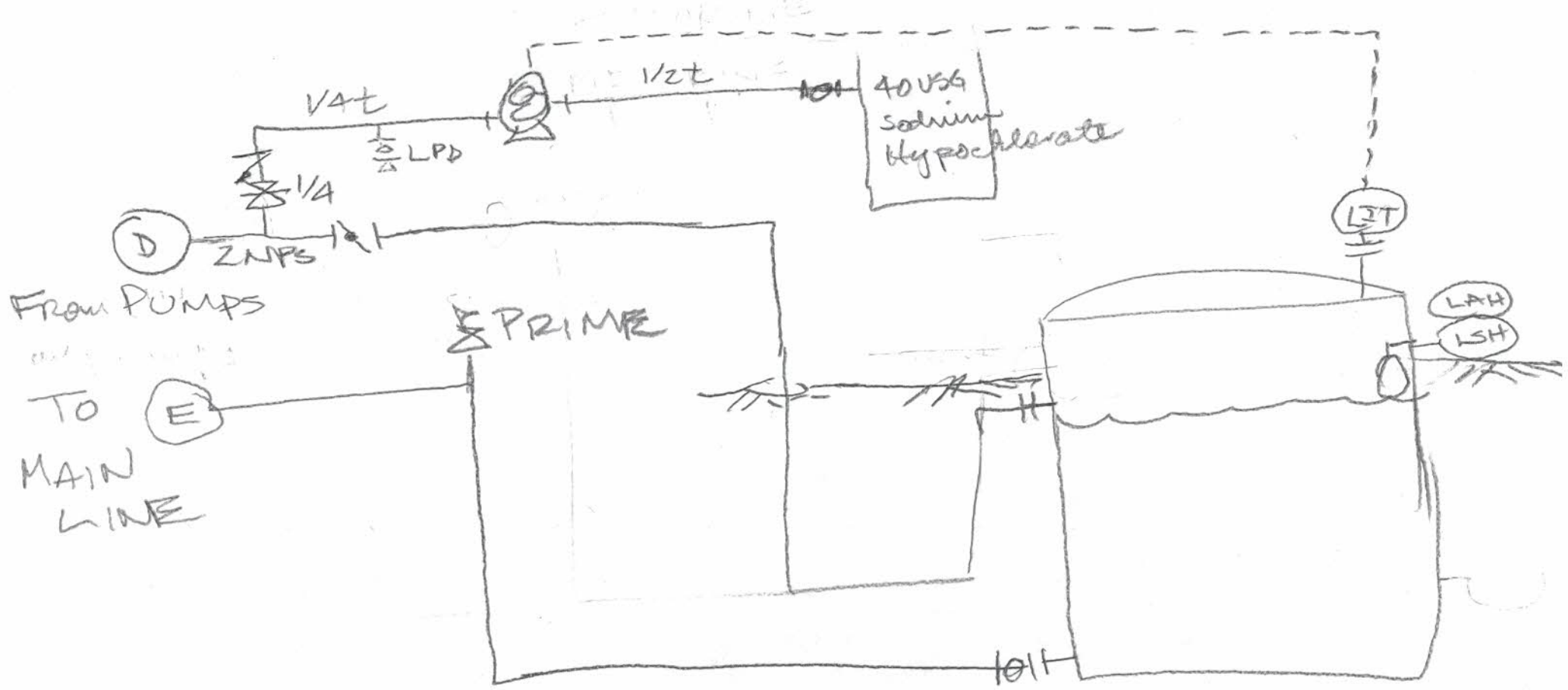


Figure D: Chlorination



Fletcher Creek Improvement District

Appendix A: Central Water Treatment Facility - Design Basis

Location: approximately 11 km south of Kaslo BC adjacent to highway 31

Google Maps coordinates 49.841996, -116.907481

Water Source: Fletcher Creek. Lake fed surface water.

Water Use: Annual use is estimated at 27,600 m3 with peak daily demand measured at 265 l/min. The design basis peak flow rate shall be 380 l/min.

Inlet water temperature: 0 to 25 ^{o}C

Electricity: A 220 VAC 100 ampere service will be made installed. It is preferred to have the electrical installed on site. All cable/conduit will be installed so as to be out of sight of the landlord. This can be achieved by locating all junction boxes, meter base, etcetera on the south wall of the building.

Water Analysis attached.

Seasonal turbidity readings attached as figure 1. The seasonal variation in turbidity clearly indicates peak sediment loading during spring runoff. Pilot filtration data over the spring runoff period indicates total particle greater than 1μ as 110 grams per 100m3 of water. Particle size distribution is 66% larger than 25μ and 34% smaller than 25 μ and larger than 1 μ. The period of low sediment loading running from September through June is currently unknown as the data gathering for the period is currently underway.

Objective: Install new equipment inside the existing intake building. A dimensioned floor plan of the existing building is being drawn. A false floor will be constructed over the existing below grade tanks. (See Photo 1 below.) The new equipment will be mounted, piped and electrified on site. The option to shop fabricate a module for transport to site and installation on Owner supplied foundation is not the first choice because we are on an easement and the landowner has indicated reluctance to allow any change to his view of the existing facility.

The method of treatment shall be particle filtration followed by Ultraviolet disinfection. Chlorine injection is to be included as an option only. Some residents are not in favor of chlorine injection but the provincial regulator is pushing in that direction. We must be prepared to include chlorine injection only if mandated at some time in the future by the regulator.

Photo 1: East end of the inside of the intake building. All storage at the east end of the building is to be relocated to west end.

Appendix B: Pump, Generator and Building Heater Sizing

1) Pump Motor and Emergency Generator Sizing

		user inputs				
	no highlight		text or calculated variables			
usgpm	100		13.36898	ft3/min	0.222816	ft3/sec
psid	30		4320	lbf/ft2		
η	50	%				
motor hp	3.5					
motor kw	2.6		14	amps at 220VAC		
motor power factor	0.83					
size generator for motor load times	2	allowing for start up inrush current				
generator size	6	kW	33	amps at 220VAC		
Today's date:	2022-01-23					
By:	N. C. Kelly					

2) Building heater Sizing

Building Dimensions

height	8	ft
depth	20	ft
width	20	ft

heat transfer areas			"R" value	design temp diff (F)	Q (btuh)
ceiling	400	ft2	20	60	1200
walls	640	ft2	12	60	3200
floor	400	ft2	10	60	2400
				total bldg heat btuh	6800
Today's date:			2022-01-23		
By:			N. C. Kelly		

3) Lift Pump Data Sheet

Q	100	usgpm			
TDH at Q	30	psid			
fluid SG	1				
flow T	40	max °C			
	0.5	min °C			
suction pressure	8.02	psia min			
	11.05	psia max			
NPSHA	16	Ft			
atmospheric pressure	13.8	psia	31.8	ft of water	
head difference bttm of tk to pump suction	11	ft max	4	ft min	
fluid vapor pressure	0.9503	psia at max flowing temp			
fluid vapor pressure	2.19652	ft			
NPSHA	16.3	ft			

Machine Performance:

1) performance curve MUST have a continuous negative slope from shutoff to runnout
2) installed impeller shall not be greater than 80% of the max impeller for the case
3) seal-less design is imperative. Magnetic drive preferred.
4) motor shall be sized for runnout
5) Motor shall be 220/240 VAC 60 Hz single phase open drip proof or TEFC suitable for non hazardous but wet area classification.
6) all fluid wet materials shall be NSF 61 food grade certified

Vendor shall specify in his proposal:

a) Pump end connection size, type and rating
b) Overall space requirement by providing a dimensioned drawing of the pump and motor assembly.
c) expected life in a continuous operations environment.
d) warranty conditions.
e) price and delivery in weeks from receipt of order and owner approved dimensioned drawing and performance curve
f) Priced recommended spare parts list
g) Complete spare parts list
h) Installation instructions/requirements

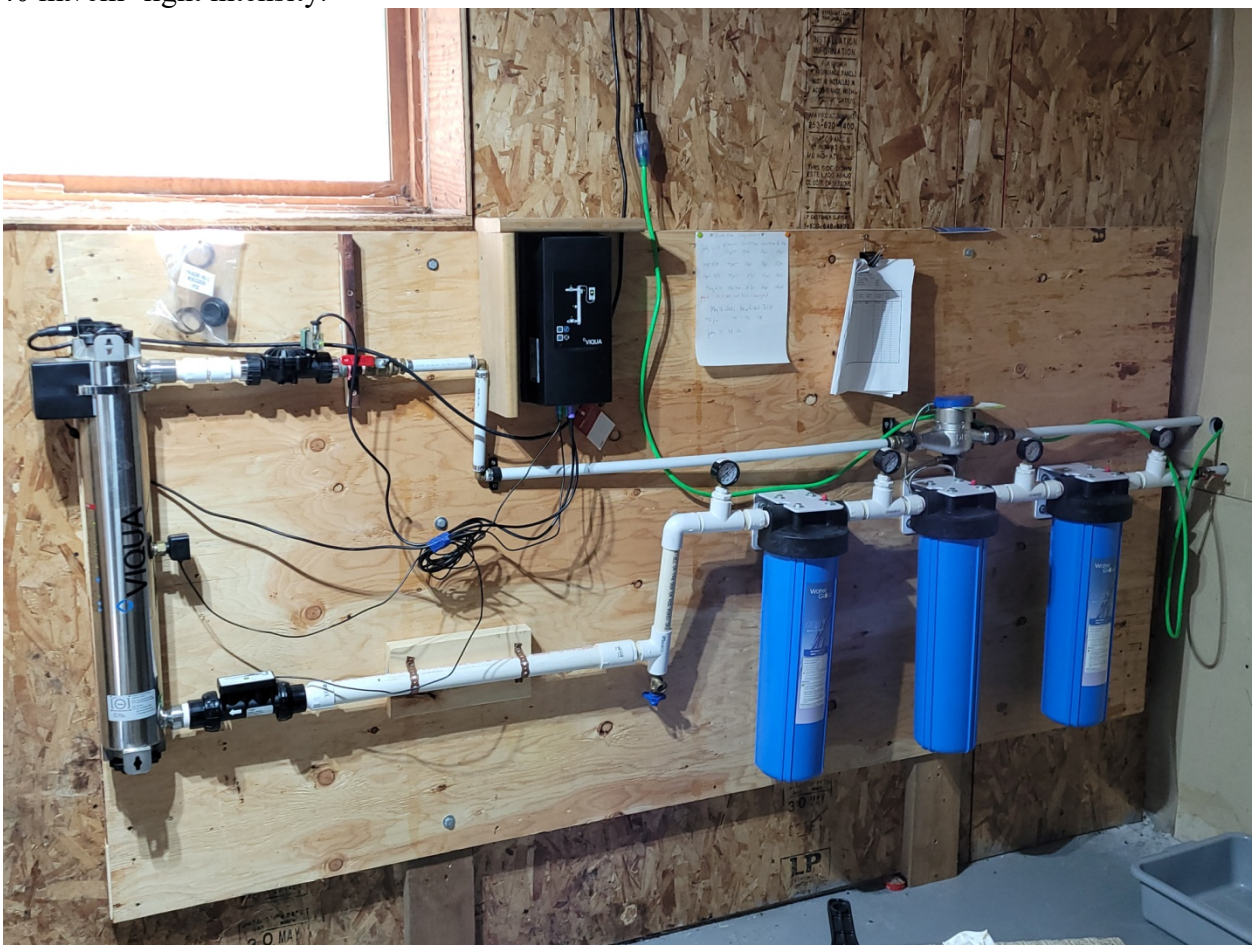
FLETCHER CREEK IMPROVEMENT DISTRICT
RR2, Site 3, Comp 38
Kaslo, BC V0G 1M0
Website: www.fletchercreekwater.com
Email: fletchercreekwater@gmail.com

Appendix C: Interim Report: Fletcher Creek Improvement District Pilot Study

Purpose of the Pilot Study: The purpose of the pilot study is to gather data to develop a design basis for the treatment of water sourced from the Fletcher Creek. The Pilot Study will prove the effectiveness of particle filtration and ultra violet disinfection to yield potable water meeting the *Guidelines for Canadian Drinking Water Quality*[1].

Methodology: Use Fletcher Creek water as the feed to a three stage filtration system with ultraviolet disinfection. Cumulative water throughput of the filter media and corresponding pressure drop (at a measured flow rate) will be recorded[2]. Test the treated water on a regular interval to demonstrate compliance with Provincial potable water objectives[3].

Apparatus: In Phase I of the study, an existing treatment system installed in 2018 was used as the test site. The treatment system includes a volumetric flow meter[4], a primary 75/25 micron filter, a secondary 25/01 micron filter, a 1 micron absolute filter, and an ultraviolet disinfection cell. The filter housings are the common 20" "Pentek Big Blue" available from The Water Guy and others. The ultraviolet disinfection cell is a Viqua PR020, is NSF 55 Class A compliant, and is capable of treating 20 usgpm at 40 mJ/cm^2 light intensity.

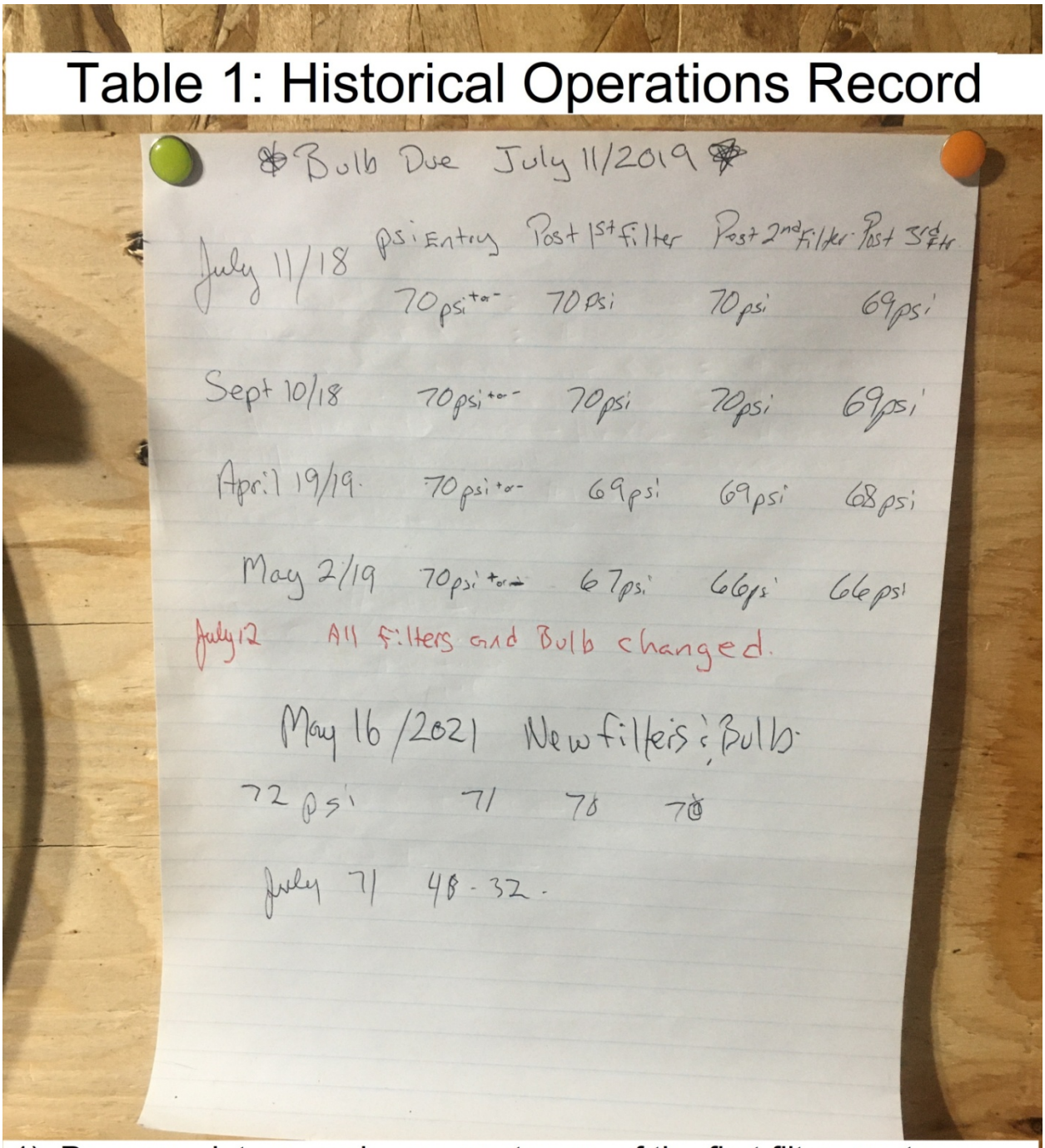


Results:

1) The test was initiated May 16, 2021. The cartridges were weighed new, before being put into service.
2) The volumetric flow meter reading was recorded.
3) The overall pressure drop was noted (not recorded) as zero.
4) The pressure drop across the filtration system was deemed excessive but was not recorded.
5) Phase II of the study was initiated on September 1, 2021.
6) The in-service filter cartridges were removed and set into pails to drain.
7) New cartridges were weighed and installed.
8) The volumetric flow meter reading was recorded as 5800 ft3 (160,000 litres).

Appendix A: Operations Log

Table 1: Historical Operations Record



1) Pressure data records are upstream of the first filter, upstream of the second filter, upstream of the third filter and upstream of the UV cell.
2) The data recorded for "July" presents only three data points; inlet to system, downstream of first filter, and upstream of the UV cell. Thus, overall system pressure drop is 71-32=39 psi.

The filter cartridges were allowed to drain with the sediment and water collected in pails. The cartridges were weighed routinely to determine how much sediment was collected in each. When the weight of the cartridge stopped changing, it was deemed dry so the weight difference from new to used could be attributed to collected sediment.

Date	Water Meter Reading (ft3)	Weight of 7525 cartridge (grams)	Weight of 2501 cartridge (grams)	Weight of 1 abs cartridge (grams)
2021-05-16	0	812	898	531
2021-09-01	5800	931	914	574
Mass collected in cartridge(g)=		119	16	43
Mass collected in drain pail(g)=		3	Too small to measure	Too small to measure
Total Mass collected (g)=		122	16	43

Qualitative Evidence:

Visual Inspection of the cartridge elements allows some qualitative assessment. See the annotated photographs below:

Figure 1: The three filter cartridges at the end of Phase I

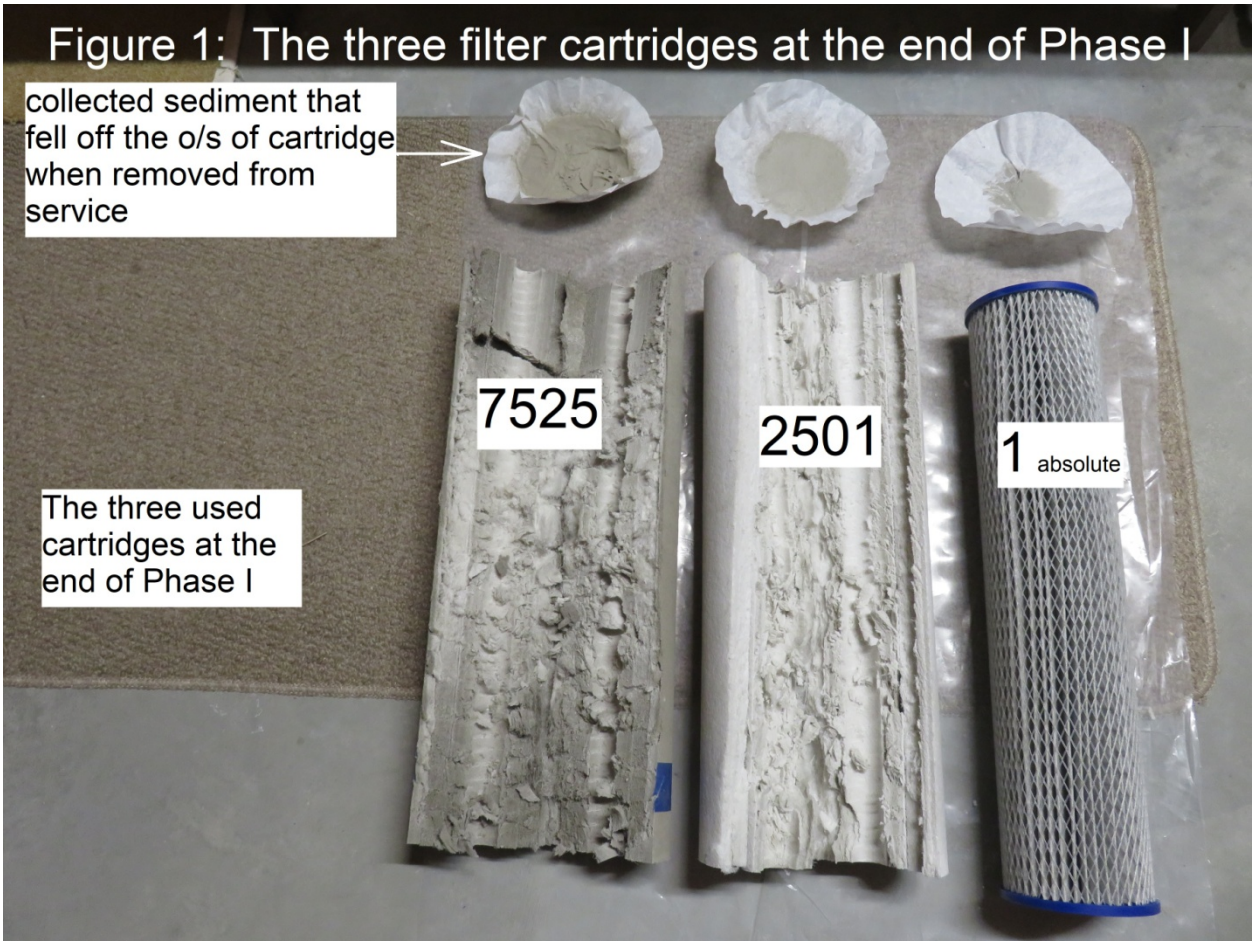


Figure II: 7525 Internals After Use

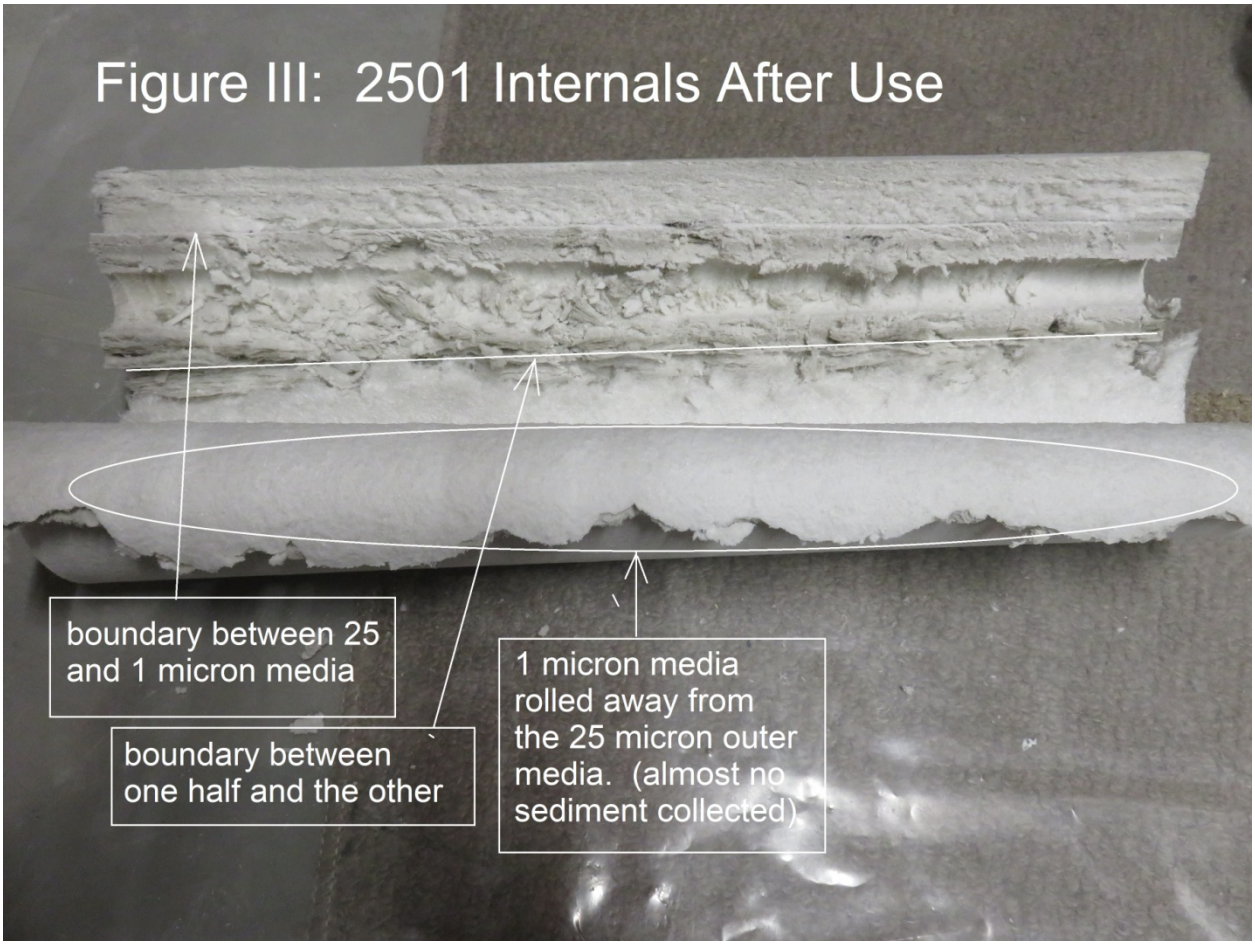


Figure III: 2501 Internals After Use
boundary between 25 and 1 micron media
boundary between one half and the other
1 micron media rolled away from the 25 micron outer media. (almost no sediment collected)

Figure IV: External Skin of 7525 Media After Use

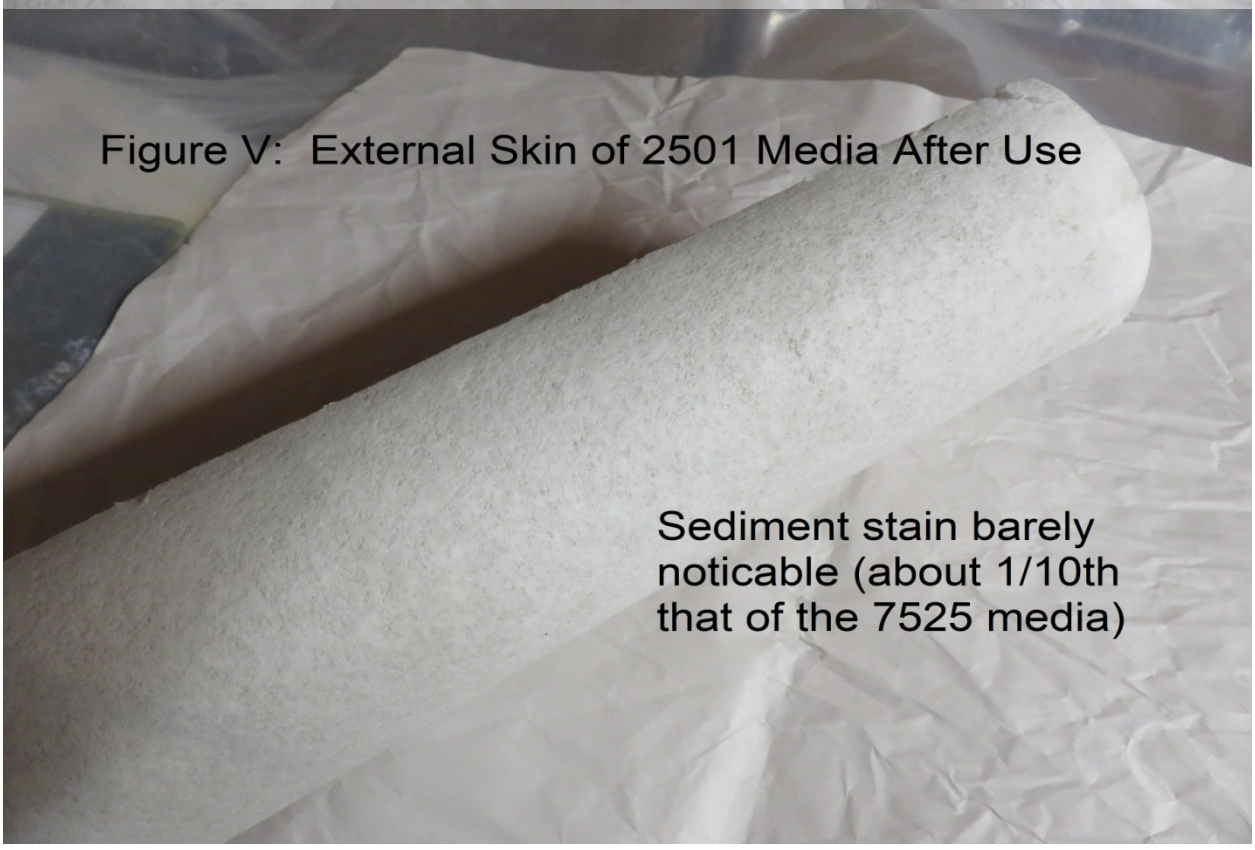


Figure V: External Skin of 2501 Media After Use

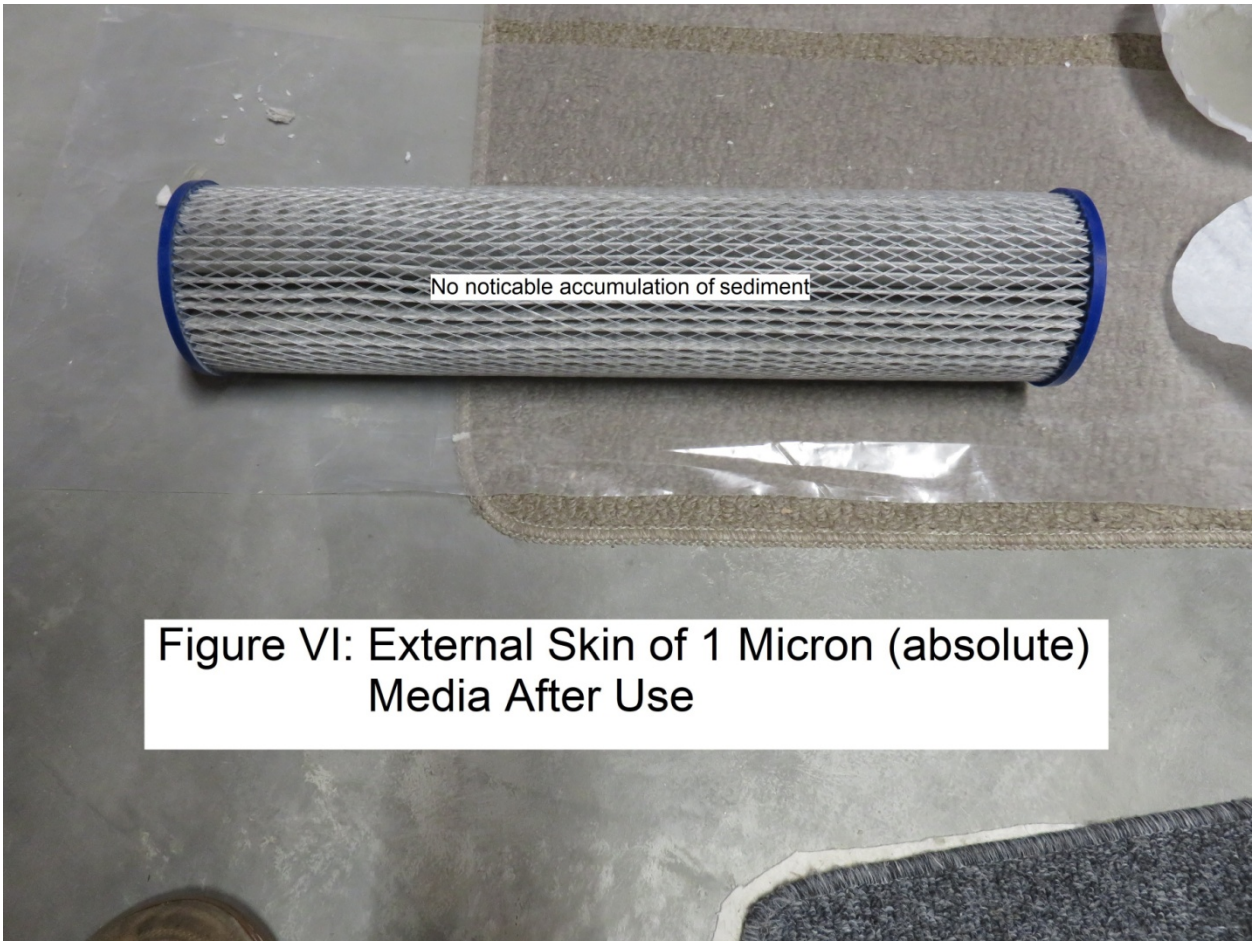


Figure VI: External Skin of 1 Micron (absolute) Media After Use

Observations:

1) The sediment collected in the 7525 filter is significant. The sediment is collecting in both the 75 micron and the 25 micron media. The filter is likely aptly applied.

2) The sediment collected in the 2501 filter is very small. Sediment is not being collected in any observable amounts in either the 25 or the 1 micron media. This filter could likely be eliminated.

3) The sediment collected in the 1 micron absolute filter is significant but only 1/3 that collecting on the 75/25 filter. The external surface of the filter media has no visible accumulation of sediment.

Footnotes:

1 Phase I data does not include treated water turbidity measurement but it will be included in successive phases once the intake turbidity rises above 1 NTU.

2 Pressure drop as a function of flow rate was not recorded as part of Phase I but will be included in successive phases.

3 The host of the pilot study has been operating the treatment system since 2018 and has a perfect record for water analysis by Interior Health meeting Interior Health's specifications.

4 The volumetric flow meter was the only piece added in the spring of 2021 specifically for the pilot study.