SGW-65559
Revision 0

Impacts and Recommendations Regarding Transfer of Modular Storage Unit Water Comingled with BP-5 and DV-1 Feed Streams

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
under Contract DE-AC06-08RL14788

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Document Type: RPT Program/Project: S&GRP

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Date Published
November 2020

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By Sarah Harrison at 2:25 pm, Dec 03, 2020

Release Approval Date

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Terms

200 West P&T	200 West Pump and Treat Facility
IDF	Integrated Disposal Facility
ITB2	Injection Transfer Building 2
IX	ion exchange
MSU	modular storage unit
TDS	total dissolved solids

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1 Introduction

The purpose of this document is to update the evaluation of accepting modular storage unit (MSU) water at the 200 West Pump and Treat Facility (200 West P&T). Although the MSU water is an accepted feed stream (SGW-59872, *Feed Stream Acceptance Criteria for 200 W Pump and Trea*t), there have been several changes since water from the MSUs were originally considered an accepted feed stream. The most significant change is the suspension of biological treatment. The acceptance criteria in SGW-59872 have been adjusted to reflect this suspension and that change is not covered in this document. This document focuses on the transfer of the MSU water in the same pipeline as the 200-BP-5 and 200-DV-1 water. These feed streams will be combined in the transfer tank in the 200 East Area, resulting in a new blend of water.

This new blend is planned to be mixed with water from A and C Farms and treated by a new ion exchange (IX) system, the effluent of which is planned to be routed directly to Injection Transfer Building 2 (ITB2) and bypass the effluent tank. In addition, leachate from the Integrated Disposal Facility (IDF) is planned to be transferred to the MSUs for eventual processing at the 200 West P&T. This planned routing would result in a unique blend of waters that has not yet been evaluated. Therefore, an assessment of feed stream acceptance is warranted. This document evaluates this new blend of water and augments the previous assessments of MSU acceptance.

In summary, this document addresses the following changes anticipated as part of bringing A and C Farm water to the 200 West P&T:

- The pipe line previously used to transfer MSU water (and only MSU water) has been repurposed to transfer feed streams from the MSUs, 200-BP-5, 200-DV-1 (perched), and IDF leachate
- The MSU water will be passed through IX along with water from several extraction wells
- After IX treatment, the water will pass directly to ITB2 rather than to the effluent tank, resulting in a unique blend

2 Previous Documents Impacted by Using Modular Storage Unit Transfer Pipeline for New Feed Streams

There are a number of documents that evaluate the impact of the MSU water on the 200 West P&T. The following list includes the most relevant documents. The significance of these documents is that they provide background on the MSUs, how they are used as part of the 200 West P&T remedy, water quality in the MSUs, the optimization test performed to evaluate treatment of MSU water at the 200 West P&T, and the approved steps developed to transfer MSU water and avoid potential exceedances of effluent limits. The following reports are provided for reference:

- SGW-61673, *Treatment of Modutank Water At 200 West Pump And Treat*
- SGW-61287, *Impact of Modutank Water on the 200 West Pump and Treat*
- DOE/RL-2019-28, *200-DV-1 Operable Unit Laboratory Treatability Study Test Plan*
- DOE/RL-2018-70, *Optimization Pilot Test Results of Treating Water from Modular Storage Units at 200 West Pump & Treat Facility*

A related document that assesses the possible acceptance of IDF leachate at the 200 West P&T is SGW-65049, *200 West Pump and Treat Feed Stream Evaluation: Integrated Disposal Facility Leachate*. This assessment concluded clear advantages of transferring the IDF leachate to the MSU and leveraging the established approach for transferring MSU water. The evaluation of IDF leachate is reported in SGW-65049.

3 Modular Storage Unit Transfer

An optimization test was performed in 2018 to evaluate the feasibility of treating MSU water at the 200 West P&T rather than at the Effluent Treatment Facility. The Effluent Treatment Facility is a facility designed to treat liquid effluent from the Waste Treatment and Immobilization Plant and experienced difficulty treating water from the MSU. The optimization test plan and final report are documented in DOE/RL-2018-28, *Optimization Test Plan for Treating Water from Modular Storage Units at 200 West Pump & Treat Facility*, and DOE/RL-2018-70, respectively.

The final report provided conditional approval to treat MSU water at the 200 West P&T. The conditions were based on the lessons learned from the optimization test. The steps recommended to support ongoing efforts to meet the 200 West P&T acceptance and effluent quality criteria are as follows:

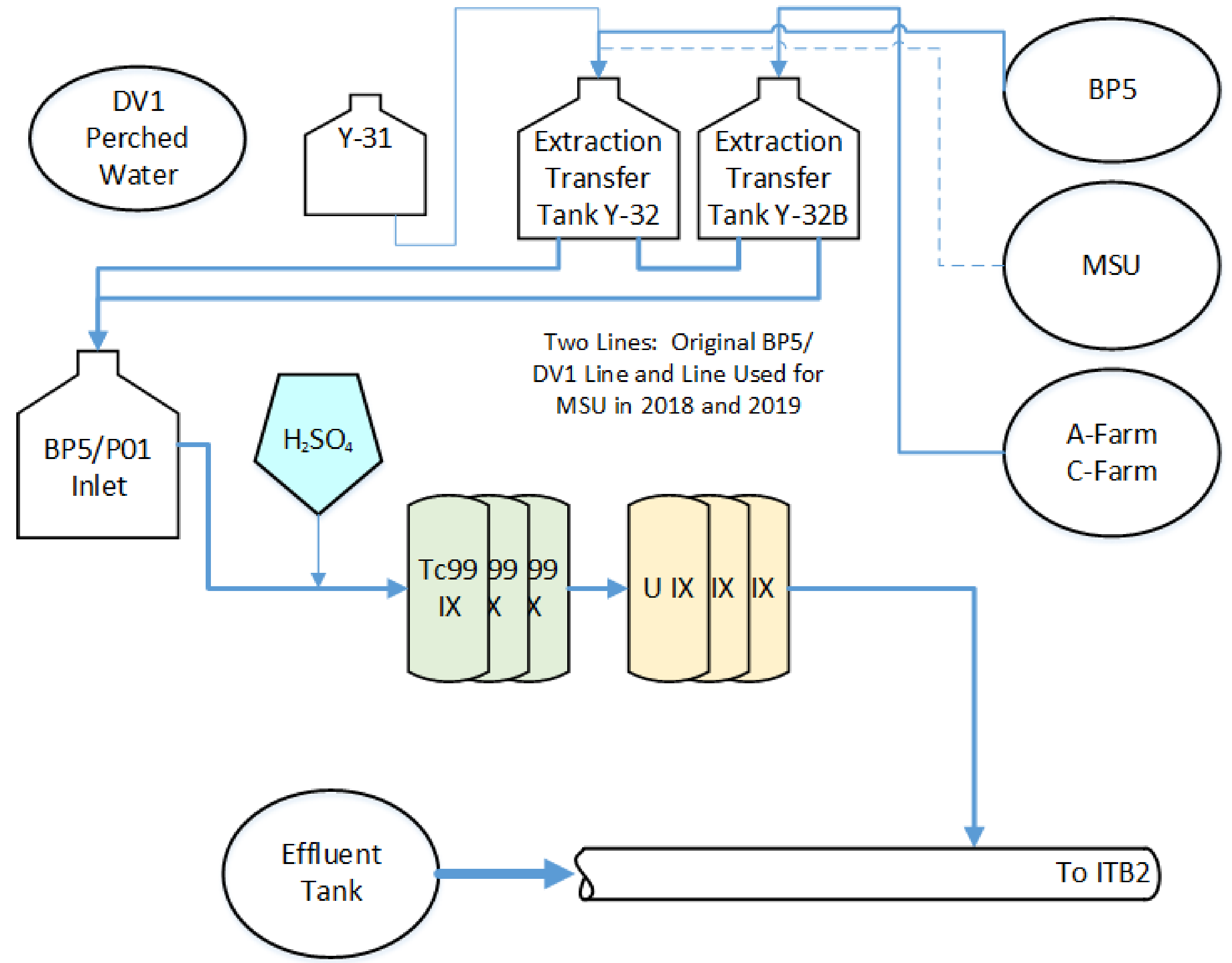
1. Isolate the water to be transferred so additional contaminants are not introduced.
2. Sample the MSUs and review the results against the acceptance criteria.
3. Chlorinate the MSUs to clear algae and bacteria and to oxidize iron and manganese.
4. Calculate the blend ratio of the MSU water and use this value to manage the flow rate from the Z-line trench to the recycle tank. A blend ratio of 0.0225 is recommended for planning purposes based on the total dissolved solids (TDS) concentrations being the primary limiting factor.

During water transfer from the MSUs, the water should be filtered. A pore size of 100 µm or smaller is recommended to prevent debris from entering the pipeline. MSU water is transferred on an as needed basis to augment evaporation. Transfers are infrequent, occurring less than once a year. The amount of MSU water needed to be transferred has decreased since the injection wells have not needed to be rehabilitated. Changes in the amount and quality of water in the MSUs is covered in Chapter 8 of this report. This evaluation is performed in the context of this decreasing need to transfer.

4 Process Flow

Figure 1 shows the expected flow path. The MSU water will be mixed with water from 200-DV-1 (perched) and 200-BP-5, in tank Y-32. The water from A Farm and C Farm will be transferred to a new extraction transfer tank, which will be located near the existing extraction transfer tank Y-32. The new extraction transfer tank will be designated Y-32B and be connected to the existing tanks Y-32. A common pump station will transfer the water to the 200 West P&T in the 200-BP-5/200-PO-1 inlet tank. Before treatment, the pH is adjusted to about 6.8 to avoid fouling the IX resin with calcium carbonate precipitation. The water is pumped through two IX systems, one to remove technetium-99 (Tc-99) and the other to remove uranium. After treatment, the water is transferred to an existing pipeline that conveys treated water to ITB2.

Sampling of the water in the ITB2 tank will need to be added to the current monthly sampling plan to capture the quality of the water being injected in the west wells.



Notes: Line weight roughly corresponds to flow.
Dashed line for MSU represents intermittent flow.
Extraction transfer tanks will be manifolded and served by one pump station. MSU may be connected to either tank; design is in process.
ITB2 = Injection Transfer Building 2
MSU = modular storage unit

Figure 1. Proposed Process Flow for Water from the East Area

5 Flow Rates

The flow rate of the various streams impact the nature of the final blend of water to be treated and conveyed to the injection wells. The following flow rates are provided to document the assumptions made in this evaluation. As the 200 West P&T is expanded, the flows will change and the recommendations in this document should be revisited in light of those changes.

Table 1 lists flow streams and the flows used. Note that these values are provided to clearly document the approach used. They are not provided to set policy or recommend flow rates. This discrepancy is especially notable for the A Farm and C Farm wells. For cleanup purposes, the flow rates of 284 and

662 L/min (75 and 175 gal/min) have been discussed. This evaluation uses flow rates of 284 and 473 L/min (75 and 125 gal/min) as a response to limited pipeline capacity.

Table 1. Flow Rates Used in This Evaluation

Flow Stream	Flow in L/min (gal/min)	Comments
200-DV-1 (perched) water	9.5 and 38 (2.5 and 10)	The perched system currently exists of three wells that operate intermittently producing about 3.79 L/min (1 gal/min). The system is expected to be expanded. DOE would like to target 10 gal/min, but the technical feasibility of reaching this target is under review. A flow rate of 9.5 L/min (2.5 gal/min) is more likely and was used as a lower bound.
200-BP-5	625 (165)	There are three 200-BP-5 wells that are operated at a combined 625 L/min (165 gal/min). This flow rate is expected to continue for the foreseeable future.
C Farm	284 and 473 (75 and 125)*	The C Farm well is expected to be operated at 284 L/min (75 gal/min) for the first 5 or 6 years. At that time, the flow rate will be increased to 473 L/min (125 gal/min).
A Farm	284 and 473 (75 and 125)*	The A Farm well is expected to be operated at 473 L/min (125 gal/min) for the first 5 or 6 years. At that time, the flow rate will be decreased to 284 L/min (75 gal/min).
MSU	0, 95, and 189 (0, 25, and 50)	The MSU is an intermittent flow, transferring once every 12 to 24 months. The transfers are only expected to last a week or two. Most of the time, the MSU will not be pumped, so a flow of 0 is included to provide a baseline. Flows of 6.5 and 13 L/min (25 and 50 gal/min) were based on typical transfer rates that have been used in the past.
Effluent tank to ITB2	4,921 (1,300)	A flow of 4,921 L/min (1,133 gal/min) is based on a flow of 6,435 L/min (1,700 gal/min) to ITB2. An allowance of 1,514 L/min (400 gal/min) was provided for water from the east area (and treated by the two IX systems). The balance of flow leaves the effluent tank (6,435 L/min – 1,514 L/min = 4,921 L/min).

*Note that flows of 75 and 175 gal/min have been recommended for cleanup. Flows of 75 and 125 gal/min are used in this evaluation as a response to limited pipeline capacity.

DOE = U.S. Department of Energy

ITB2 = Injection Transfer Building 2

IX = ion exchange

MSU = modular storage unit

A total flow to ITB2 is assumed to be 6,435 L/min (1,700 gal/min). This is a very conservative value in the sense that it limits the amount of water from the effluent tank to be blended with the water from the 200 East Area. Once the third air stripper is installed, the flow to ITB2 may be as great as 11,356 L/min (3,000 gal/min).

6 Water Quality

The acceptance of a new feed stream is dependent on the ability of the 200 West P&T to treat the water and meet the cleanup criteria. The acceptance criteria are documented in SGW-59872. The water quality in each source is first reviewed. Then the water quality in potential blends is explored.

6.1 Water Quality in the Modular Storage Units

The MSUs are typically sampled twice annually and in advance of transfer to the 200 West P&T. Sometimes these sampling efforts are combined. Table 2 shows the concentration of key contaminants in the MSU at select times. The period of 2014 through 2017 was before any transfer to the 200 West P&T. Then, beginning in June 2018, the MSU was sampled before each transfer to the 200 West P&T as part of the optimization test.

Table 2. Chemical Characterization of MSU 3

Contaminant	Unit	Average 2014 Through 2017	June 5, 2018, Before Pumping	July 2, 2018, Before Filtration	July 10, 2018, Before Filtration	10/17/2018 Before Filtration	4/2/2019 (Not Filtered Unless Noted)
Alkalinity	mg/L as $CaCO_3$	198	141	259	300	235	316
Arsenic	µg/L	3.47	5	<5	<5	<5	5.66
Calcium	mg/L	81.2	22.4	41.0	45.6	32.3	38.0
Carbon tetrachloride	µg/L	<0.3	<0.3	0.39	0.49	<0.3	<0.3
Chloride	mg/L	166	230	1,100	1,400	1,300	1,750
Chloroform	µg/L	<0.3	<0.9	95.6	99.2	<0.3	3.08
Chromium (hexavalent)	µg/L	No data	<1.5	<1.5	<1.5	4.7	21.7
Chromium (total)	µg/L	5.58	1.05	1.35	1.17	1.34	<1
cis-1,2-Dichloroethene	µg/L	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Cobalt-60	pCi/L	<5.77	<5.77	<5.77	<5.77	<1.36	Reported = -2.11 MDC = 9.27
Cyanide (total)*	µg/L	No data	<1.67	<1.67	<1.67	<1.67	9
Gross alpha	pCi/L	10.13	<1.41	<1.41	<1.41	<3.56	Reported = 5.68 MDC = 13.7
Gross beta	pCi/L	63.8	27.9	64.8	36	42.7	34.1
Iodine-129	pCi/L	0.980	4.05	1.75	2.82	4.12	2.8
Iron	µg/L	541	74.8	45.7	34.1	170	103
Magnesium	mg/L	35.0	27.0	39.4	42.6	53.9	62.9

Table 2. Chemical Characterization of MSU 3

Contaminant	Unit	Average 2014 Through 2017	June 5, 2018, Before Pumping	July 2, 2018, Before Filtration	July 10, 2018, Before Filtration	10/17/2018 Before Filtration	4/2/2019 (Not Filtered Unless Noted)
Manganese	µg/L	1399	91.3	116	134	218	122
Nitrate as nitrogen	mg/L	0.43	<0.028	0.89	<2.8	<0.028	0.1
Potassium	mg/L	23.2	21.0	29.9	30.1	42.3	37.7
pH	unitless	9.45	9.10	7.91	8.3	8.84	8.93
Sodium	mg/L	156.5	171	730	754	767	1,100
Strontium-90	pCi/L	15.05	0.928	2.23	4.06	3.12	2.65
Sulfate	mg/L	248	100	110	140	170	164
Technetium-99	pCi/L	38.2	<40	<40	<40	<47.3	Reported = 22.3 MDC = 36.9
Total dissolved solids	mg/L	985	801	2350	2680	2500	3360
Total suspended solids	mg/L	50.8	0.645	1.48	5.6	59	28.8
Trichloroethylene	µg/L	<0.3	<0.3	<0.3	<0.3	<0.3	3.18
Tritium	pCi/L	2,254	3,370	3,520	3,480	2,240	1,810
Uranium	µg/L	12.5	0.665	1.36	1.51	1.74	2.68

*Assumes cyanide in the form of ferrocyanide, the form used on the Hanford Site.

BD = below detection

MDC = minimum detectable concentration

The nature of the water in the MSUs changes depending on the source of the water that is placed into them and how long the water has been evaporating. Evaporation tends to concentrate dissolved solids such as sodium, chloride, and calcium. In addition, algal activity raises the pH and removes some of the metals, which end up in the sediment. With some exceptions, the most recent data were used to represent the MSU water in the calculation of various blends of water possible should the MSU water be transferred along with the water from 200-BP-5 and 200-DV-1. The exceptions include chloroform, iodine-129 (I-129), strontium-90, and cobalt-60 (Co-60). In many exceptions, the maximum value was used in place of the most recent concentration. In the case of Co-60, the most recent value was negative, so the detection limit was used to represent the MSU water. These data are listed in Table 3. Note that the feed stream acceptance from MSU requires sampling the MSU before transfer to use measured values to verify treatability and determine the blend ratio.

Table 3. MSU Concentrations Used to Calculate Concentration in Various Blends

Contaminant	Unit	Concentration Used to Calculate Blend
Alkalinity	mg/L as $CaCO_3$	316
Arsenic	µg/L	5.66
Calcium	mg/L	38
Carbon tetrachloride	µg/L	0.3
Chloride	mg/L	1750
Chloroform	µg/L	99
Chromium (hexavalent)	µg/L	21.7
Chromium (total)	µg/L	1
cis-1,2-Dichloroethene	µg/L	0.3
Cobalt-60	pCi/L	9.27
Cyanide (total)	µg/L	9
Gross alpha	pCi/L	5.68
Gross beta	pCi/L	34.1
Iodine-129	pCi/L	4.12
Iron	µg/L	103
Manganese	µg/L	122
pH	Unitless	8.93
Sodium	mg/L	1100
Strontium-90	pCi/L	4.06
Sulfate	mg/L	164
Technetium-99	pCi/L	22.3
Total dissolved solids	mg/L	3,360
Total suspended solids	mg/L	28.8

MSU = modular storage unit

A review of the expected water quality from IDF indicates that the IDF water would have a small impact on the water quality in the MSU. The iron concentrations are notably greater in the IDF leachate (1,770 µg/L) than assumed for the MSU (103 µg/L). However, iron typically settles out in the MSU, and the IDF water is not expected to increase the iron in the MSU after settling occurs.

6.2 C Farm, A Farm, 200-BP-5, 200-DV-1 Perched Water

The water from C Farm, A Farm, 200-BP-5, and 200-DV-1 (perched) are listed in Table 4. It is notable that the Tc-99 in C Farm is expected to decrease rapidly once pumping starts and within a year may decrease to half its original value. To be conservative, the initial C Farm Tc-99 concentration was used to calculate the concentration in the blend. These concentrations are presented in Table 4 to serve as a reference to document the values used to calculate the blended concentrations presented in the next section.

Table 4. Water Quality from 200 East Area Sources

Contaminant	Units	C Farm Concentration	A Farm Concentration	200-BP-5 (299-E33-360) Concentration	Perched Water (299-E33-344, 350, and 551) Concentration
Alkalinity	mg/L as $CaCO_3$	100	97	408	284
Arsenic	µg/L	6.2	6.8	8.13	10.5
Calcium	mg/L	110	27	49.5	250
Carbon tetrachloride	µg/L	<0.3	<0.3	<0.3	<0.3
Chloride	mg/L	37	27	17.6	78.8
Chloroform	µg/L	a	<0.3	<0.3	<0.3
Chromium (hexavalent)	µg/L	9.3	7.3	6.1	63.4
Chromium (total)	µg/L	9.3	7.3	6.5	71.7
cis-1,2-Dichloroethene	µg/L	No data	<0.3	<0.3	<0.3
Cobalt-60	pCi/L	0.255	-1.79	-0.827	2.29
Cyanide	µg/L	16.9	2.9	135	1.6
Gross alpha	pCi/L	<2.5	17.4	<.18	20,775
Gross beta	pCi/L	7,447	1,580	3.8	35,000
Iodine-129	pCi/L	6.3	5.9	2.38	3.41
Iron	µg/L	34	41.6	47.3	46.3
Magnesium	mg/L	5.4	5.2	18.9	78.8
Manganese	µg/L	0.5	1.9	<1	6.5
Nitrate	mg/L as N	15	5.2	41.3	204
pH		7.9	7.95	7.4	7.78
Potassium	mg/L	10	8.5	250.5	13.8

Table 4. Water Quality from 200 East Area Sources

Contaminant	Units	C Farm Concentration	A Farm Concentration	200-BP-5 (299-E33-360) Concentration	Perched Water (299-E33-344, 350, and 551) Concentration
Sodium	mg/L	21.8	100	56	389
Strontium-90	pCi/L	2.06	<1	<0.34	No data
Sulfate	mg/L	282	186	90.5	536
Technetium-99	pCi/L	9,230	1,000	2,846	42,700
Total dissolved solids	mg/L	633	613	800	1,873
Total suspended solids	mg/L	No data[b]	No data[b]	No data[b]	No data[b]
Trichloroethylene	µg/L	<0.3	<0.3	<0.3	<0.3
Tritium	pCi/L	699	2225	3,600	18,000
Uranium	µg/L	4.6	3.4	61.3	50,000

a. Although no data are available, this is a degradation product of carbon tetrachloride and because carbon tetrachloride is below detection, this constituent is not likely present and assumed to be below detection.

b. After proper development, water from a well does not typically contain appreciable amounts of total suspended solids. None of the samples from these sources have been analyzed for total suspended solids.

6.3 Blends

The concentrations in representative blends were calculated using the flows and concentrations presented in previous sections. These concentrations were then compared to the acceptance criteria published in SGW-59872.

The five blends that were evaluated varied in the proportions of the five flow streams. Table 5 summarizes the flows considered for each of the five blends.

Table 5. Flow Rates Used to Calculate Blends Evaluated

Blend	C Farm	A Farm	200-BP-5	Perched	MSU	Total
Baseline	284; 75	473; 125	625; 165	9.5; 2.5	0	1,391; 368
1	284; 75	473; 125	625; 165	9.5; 2.5	94.6; 25	1,486; 393
2	284; 75	473; 125	625; 165	9.5; 2.5	189; 50	1,580; 418
3	473; 125	284; 75	625; 165	37.9; 10	94.6; 25	1,514; 400
4	473; 125	284; 75	625; 165	37.9; 10	189; 50	1,609; 425

Note: Flow rates reported in L/min; gal/min.

MSU = modular storage unit

The water quality in the resulting blends is summarized in Table 6. These blends can be compared to the cleanup levels, also listed in Table 6.

Table 6. Concentration of Contaminants in Various Blends

Contaminant	Units	Cleanup Level Unless Noted[a]	Current Blend to Tc-99 IX	Baseline Blend (C-75, A-125, 200-B-P5-165, 200-DV-1-2.5, MSU 0 gal/min)	Concentration in Blend (C-75, A-125, 200-BP-5-165, 200-DV-1-2.5, MSU 25 gal/min)	Concentration in Blend (C-75, A-125, 200-BP-5-165, 200-DV-1-2.5, MSU 50 gal/min)	Concentration in Blend (C-125, A-75, 200-BP-5-165, 200-DV-1-10, MSU 25 gal/min)	Concentration in Blend (C-125, A-75, 200-BP-5-165, 200-DV-1-10, MSU 50 gal/min)
Alkalinity	mg/L as CaCO3	No limit	114	239	243	248	245	249
Arsenic	µg/L	10 (drinking water limit)	4.1	7.3	7.2	7.1	7.2	7.1
Calcium	mg/L	No limit	53	56	54	53.5	68	67
Carbon tetrachloride	µg/L	3.4	241	0.15	0.16	0.17	0.16	0.17
Chloride	mg/L	No limit	15	25	135	232	135	230
Chloroform	µg/L	60 (drinking water limit)	4.1	0.27	6.6	12	6.4	12
Chromium (hexavalent)	µg/L	48	21	7.6	8.5	9.2	9.7	10
Chromium (total)	µg/L	100	21	7.8	7.4	7.0	8.8	8.4
cis-1,2-Dichloroethene	µg/L	6 µg/L (300-FF-5 cleanup limit)	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Cobalt-60	pCi/L	100	0.6	-0.91	-0.26	0.31	0.04	0.58
Total cyanide	µg/L	300	5.5	65	61	61	61	61
Gross alpha - uranium (activity)	pCi/L	15 (drinking water)	No data	148	138	131	523	493
Gross beta	pCi/L	50 (drinking water)	No data	2,297	2,153	2,026	3,502	3,298
Iodine-129	pCi/L	1	1.2	4.4	4.4	4.4	4.4	4.4
Iron	µg/L	150 (well fouling)	<30	43	46	50	46	49
Magnesium	mg/L	No limit	17	12	15	18	16	19
Manganese	µg/L	15 (well fouling)	<1	1.0	8.7	15	8.5	15.2

Table 6. Concentration of Contaminants in Various Blends

Contaminant	Units	Cleanup Level Unless Noted[a]	Current Blend to Tc-99 IX	Baseline Blend (C-75, A-125, 200-B-P5-165, 200-DV-1-2.5, MSU 0 gal/min)	Concentration in Blend (C-75, A-125, 200-BP-5-165, 200-DV-1-2.5, MSU 25 gal/min)	Concentration in Blend (C-75, A-125, 200-BP-5-165, 200-DV-1-2.5, MSU 50 gal/min)	Concentration in Blend (C-125, A-75, 200-BP-5-165, 200-DV-1-10, MSU 25 gal/min)	Concentration in Blend (C-125, A-75, 200-BP-5-165, 200-DV-1-10, MSU 50 gal/min)
Nitrate	mg/L as N	Limit suspended[c]	25	25	23	22	28	26
pH	unitless	6.5 to 8.5 (2° drinking water)	7.4	7.69	7.77	7.84	7.8	7.8
Potassium	mg/L	No limit	5.6	117	111	104	109	103
Sodium	mg/L	No limit	31.8	64	130	188	117	175
Strontium-90	pCi/L	8	0.9	0.9	1.1	1.3	1.2	1.4
Sulfate	mg/L	250 (2° drinking water)	54.5	165	165	165	184	183
Sulfate after pH adjustment[b]	mg/L	250 (2° drinking water)	76.0	219	219	224	238	242
Technetium-99	pCi/L	900	1,453	3,792	3,552	3,341	5,315	5,003
Total dissolved solids	mg/L	500 (2° drinking water)	507	710	878	1,027	900	1,044
Total suspended solids	mg/L	No limit	No data	0.0	1.8	3.4	1.8	3.4
Trichloroethylene	µg/L	1	1.9	0.15	0.34	0.51	0.34	0.51
Tritium	pCi/L	20,000	2,396	2,638	2,585	2,539	2,684	2,632
Uranium	µg/L	30	0.85	370	346	326	1,278	1,203

a. From SGW-59872, *Feed Stream Acceptance Criteria for 200 W Pump and Treat*.

b. Calculated sulfate concentration after addition of sulfuric acid for pH adjustment to pH 6.8 for IX treatment.

c. The nitrate limit was suspended as per DOE/RL-2018-38, *200-ZP-1 Operable Unit Optimization Study Plan*.

° = secondary

IX = ion exchange

6.4 Acceptance Criteria

Formal acceptance criteria are documented in SGW-59872 and are normally used to determine the acceptability of feed streams. These criteria have been revised to reflect the layup of the biological treatment system. The acceptance criteria, in the present form, are not applicable to the intended flow path. The acceptance criteria assume treatment by one of three possible paths: full treatment through both IX and air stripping, air stripping only, or IX treatment only. Because the water from the 200 East Area does not contain volatile contaminants, treatment will be provided only by IX. The blended water is compared to the acceptance criteria and the cleanup levels. It is expected that contaminants such as uranium and Tc-99 exceed the cleanup criteria. The IX treatment is designed to remove both of these contaminants. The concentrations of the contaminants in the influent to the existing IX treatment is provided for reference in Section 6.3 (Table 6).

The contaminants that exceed the limits listed in Table 6, or are otherwise of concern, were considered for the ability of IX to provide treatment, as follows:

- Cyanide is removed by IX, typically to concentrations below detection.
- Gross alpha is removed by IX. Gross alpha is most likely from uranium activity.
- Gross beta is removed by IX. Gross beta is most likely from Tc-99.
- I-129 exceeds the cleanup level and is only removed to a small extent by the IX resin. I-129 is mainly from C Farm and A Farm, not the MSU.
- Iron and manganese are both known well foulants that exceed the cleanup level. The cleanup level listed is a self-imposed limit created to avoid well fouling. Iron and manganese are removed, albeit to a limited extent, by IX and are expected to be less than the cleanup level in the treated effluent.
- Nitrate treatment has been suspended for the optimization test expected to last through 2025. At the end of the study period, nitrate treatment may be reinstated. The optimization test is explained in DOE/RL-2019-38, *200-ZP-1 Operable Unit Optimization Study Plan*.
- Tc-99 exceeds the cleanup level and is readily removed by IX.
- TDS exceeds the secondary limit, which by definition, is set for aesthetics related to drinking water rather than health concerns. IX will remove modest amounts of dissolved solids. The concentration in the treated effluent is expected to be much less than the influent concentration.
- Uranium exceeds the cleanup level and is readily removed by the IX media selected specifically for uranium removal. Uranium is expected to be less than the cleanup level in the blended effluent.

Another key finding is that the various blends, although different, are not different enough to introduce a new contaminant at high concentrations. The contaminants present at concentrations exceeding the cleanup level surpass the cleanup level in all blends. Likewise, contaminants that are less than the cleanup level remain so at all blends. In the next chapter, the blended effluent is evaluated for only two blends.

7 Concentrations in Blended Effluent

The treated water will be blended with the treated water from the effluent tank. The flow used to calculate the blend concentration is as follows:

- Treated water from 200-BP-5/200-PO-1 IX system = 1,514 L/min (400 gal/min)
- Treated water from the effluent tank = 4,921 L/min (1,300 gal/min)
- Total flow to ITB2 = 6,435 L/min (1,700 gal/min)

The resulting water quality to ITB2 is listed in Table 7. None of the contaminants of concern exceed the cleanup limit with MSU water. However, TDS do exceed the secondary drinking water limit of 500 mg/L at an MSU flow of 189 L/min (50 gal/min). The flow of MSU water would need to be carefully controlled to assure that none of the secondary drinking water limits are exceeded.

Table 7. Concentrations in Various Blends in Treated Effluent to ITB1

Contaminant	Units	Cleanup Level	Current Effluent Tank (Nov. 2019 – Jan. 2020)	ITB2 Blend with MSU 200-BP-5/ 200-PO-1, 200-DV-1, MSU at 0 gal/min	ITB2 Blend with MSU 200-BP-5/ 200-PO-1, 200-DV-1, MSU at 15 gal/min	ITB2 Blend with MSU 200-BP-5/ 200-PO-1, 200-DV-1, MSU at 50 gal/min
Alkalinity	mg/L as CaCO3	No limit	85	121	122	123
Arsenic	µg/L	10 (drinking water limit)	4.7	5.3	5.3	5.3
Calcium	mg/L	No limit	61	60	60	59
Carbon tetrachloride	µg/L	3.4	~0.15	~0.15	~0.15	~0.15
Chloride	mg/L	No limit	22	23	39	71
Chloroform	µg/L	60 (drinking water limit)	0.3	0.3	1.2	3.1
Chromium (hexavalent)	µg/L	48	26.4	22.0	22.1	22.4
Chromium (total)	µg/L	100	27.0	22.4	22.4	22.2
cis-1,2-Dichloroethene	µg/L	6 µg/L (300-FF-5 cleanup limit)	<0.3	<0.3	<0.3	<0.3
Cobalt-60	pCi/L	100	0.7	0.3	0.4	0.6
Cyanide	µg/L	300	1.7	16.6	16.1	16.1
Gross alpha	pCi/L	15 (drinking water)	2.1	2.5	2.5	2.5
Iodine-129	pCi/L	1	0.4	1.3	1.3	1.3

Table 7. Concentrations in Various Blends in Treated Effluent to ITB1

Contaminant	Units	Cleanup Level	Current Effluent Tank (Nov. 2019 – Jan. 2020)	ITB2 Blend with MSU 200-BP-5/ 200-PO-1, 200-DV-1, MSU at 0 gal/min	ITB2 Blend with MSU 200-BP-5/ 200-PO-1, 200-DV-1, MSU at 15 gal/min	ITB2 Blend with MSU 200-BP-5/ 200-PO-1, 200-DV-1, MSU at 50 gal/min
Iron	µg/L	150 (well fouling)	16	22	23	24
Magnesium	mg/L	No limit	21	19	19	20
Manganese	µg/L	15 (well fouling)	0.7	0.7	1.8	4.1
Nitrate	mg/L as N	No limit[c]	25	25	24	24
pH	unitless	6.5 to 8.5 (2° drinking water)	7.1	7.0	7.0	7.0
Potassium	mg/L	No limit	5.3	33	32	30.1
Sodium	mg/L	No limit	20.2	30	40	60
Strontium-90	pCi/L	8[b]	0.2	0.4	0.4	0.5
Sulfate after pH adjustment[a]	mg/L	250 (2° drinking water)	72.7	107	107	108
Technetium-99	pCi/L	900	117	113	113	113
Total dissolved solids	mg/L	500 (2° drinking water)	403	475	500	550
Total suspended solids	mg/L	No limit	0.61	0.5	0.7	1.3
Trichloroethylene	µg/L	1	0.3	0.3	0.3	0.15
Tritium	pCi/L	20,000	1753	1974	1966	2638
Uranium	µg/L	30	1.1	1.8	1.8	1.8

a. Calculated sulfate concentration after addition of sulfuric acid for pH adjustment to pH 6.8.

b. Stontium-90 is average of 10 sample collected in 2016, 2018, and 2019.

c. Nitrate limit suspended during optimization test (DOE/RL-2019-38)

° = secondary
ITB1 = Injection Transfer Building 1
ITB2 = Injection Transfer Building 2
MSU = modular storage unit

8 Changes Impacting Modular Storage Unit Volume

Other changes at the 200 West P&T have a profound effect on the transfer of MSU water. The key change is the drastic improvement in the performance of the injection wells. Figure 2 shows the injectivity increased dramatically after the addition of sodium hypochlorite and after biological treatment was suspended. The improved performance results in less need for rehabilitation and less water being collected in the MSU. During summer 2020, this trend was augmented by a slowdown in Hanford Site activity cause by the coronavirus pandemic response. Figure 3 shows the level of water in the MSU decreased in summer 2020 to provide a freeboard of 1.37 m (4.5 ft) in MSU 3, which is greater than the maximum freeboard. The freeboard limit assures enough mass to prevent wind damage and to prevent the settled material from drying out and becoming windborne. At this point, utility water was added to both MSUs to raise the water level. The freeboard is expected to decrease as new wells are drilled, monitoring wells are sampled, and wells are rehabilitated. However, the projection of freeboard level is not expected to reach a level requiring a transfer of water in the next year. The freeboard is expected to remain greater than the minimum of 0.46 m (1.5 ft) before evaporation begins removing water in the dry summer months. The MSUs are not expected to require transfer to the 200 West P&T in 2021. Leachate from the IDF is expected to add about 3 million L (1 million gal) a year to the MSUs. This leachate has been characterized in SGW-65049. Although further characterization is necessary, the leachate is not expected to include any new contaminants. SGW-65049 recommends passing the leachate to the MSUs and transferring the leachate along with the MSU water to the 200 West P&T. This quantity of water will impact MSU operations and may cause a need to transfer. IDF water is not expected to be transferred to the MSUs in the next 12 months. The changes in the operation of the 200 West P&T has decreased the amount of water going to the MSUs, and in the near term, eliminate the need to transfer water from the MSU to the 200 West P&T. Based on these factors, the transfer to the 200 West P&T will only occur once every few years and likely be a smaller volume than has been transferred previously.

In addition to changes in the quantity of water, the quality of the water is expected to change. Micronutrients, including iron and manganese, are no longer added and the spent cleaning solution from the injection wells are expected to have less of these metals. Treatment of the water with sodium hypochlorite may not be needed in the future. It is likely that the MSU water will still need to be filtered, as described in DOE/RL-2018-70.

9 Summary and Recommendations

The pipeline used to transfer MSU water in 2018 is available and suitable to transfer water from the 200 East Area, which includes the following feed streams:

- 200-BP-5
- 200-DV-1 (perched)
- A Farm
- C Farm

If transferred with the other feed streams from the 200 East Area, the water will be directed to an IX system. Previous transfers of MSU water have been directed to the Z-line trench. This document concluded that the MSU water can be treated at the 200 West P&T.

Currently, the MSUs are sampled prior to transfer to assure treatability, and this practice should continue. Once the water quality is determined, a transfer rate can be determined. A flow rate of 76 L/min (20 gal/min) is recommended for planning purposes.

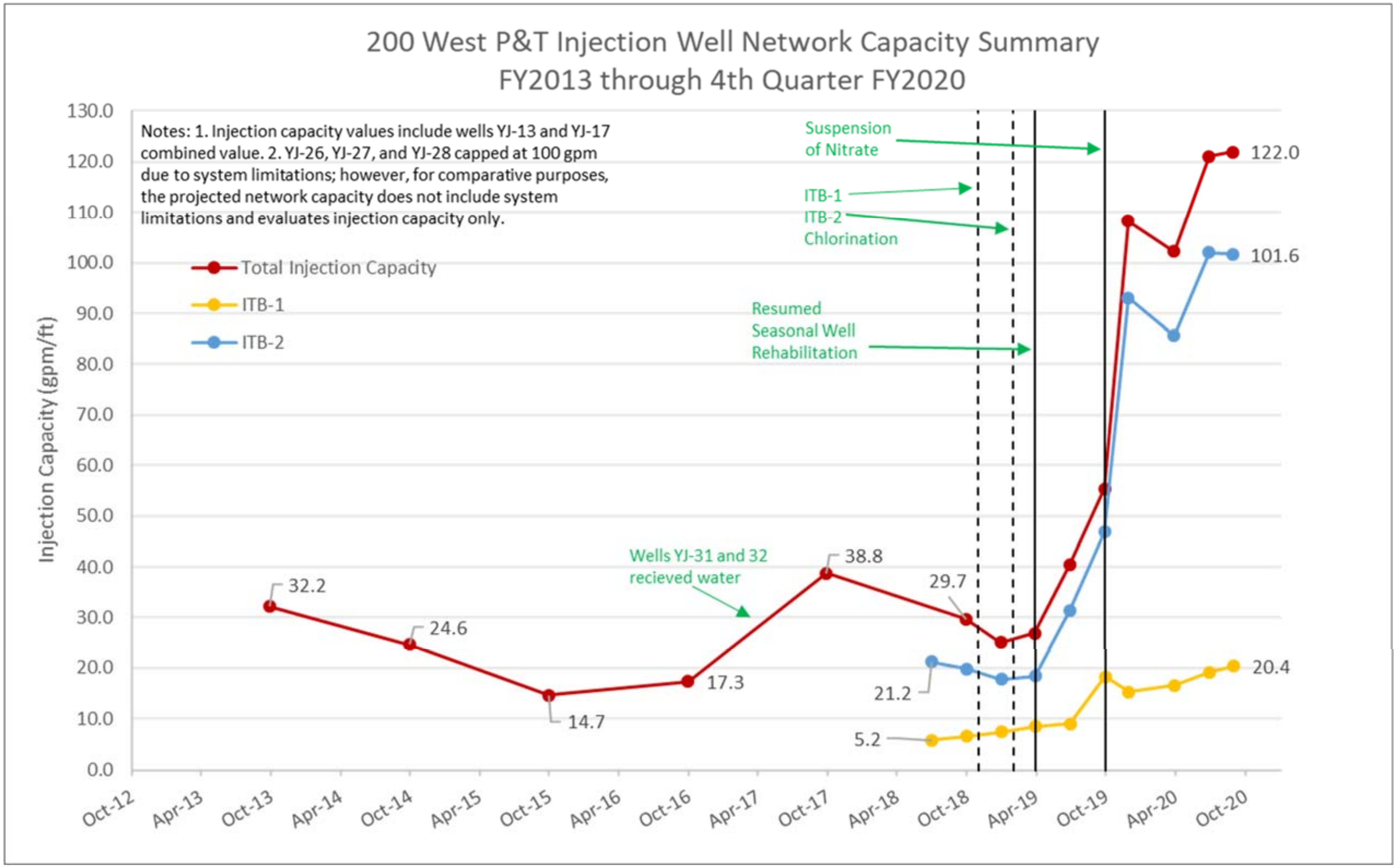


Figure 2. Specific Injection Capacity of the 200 West P&T Injection Network Over Time Showing Recent Increase

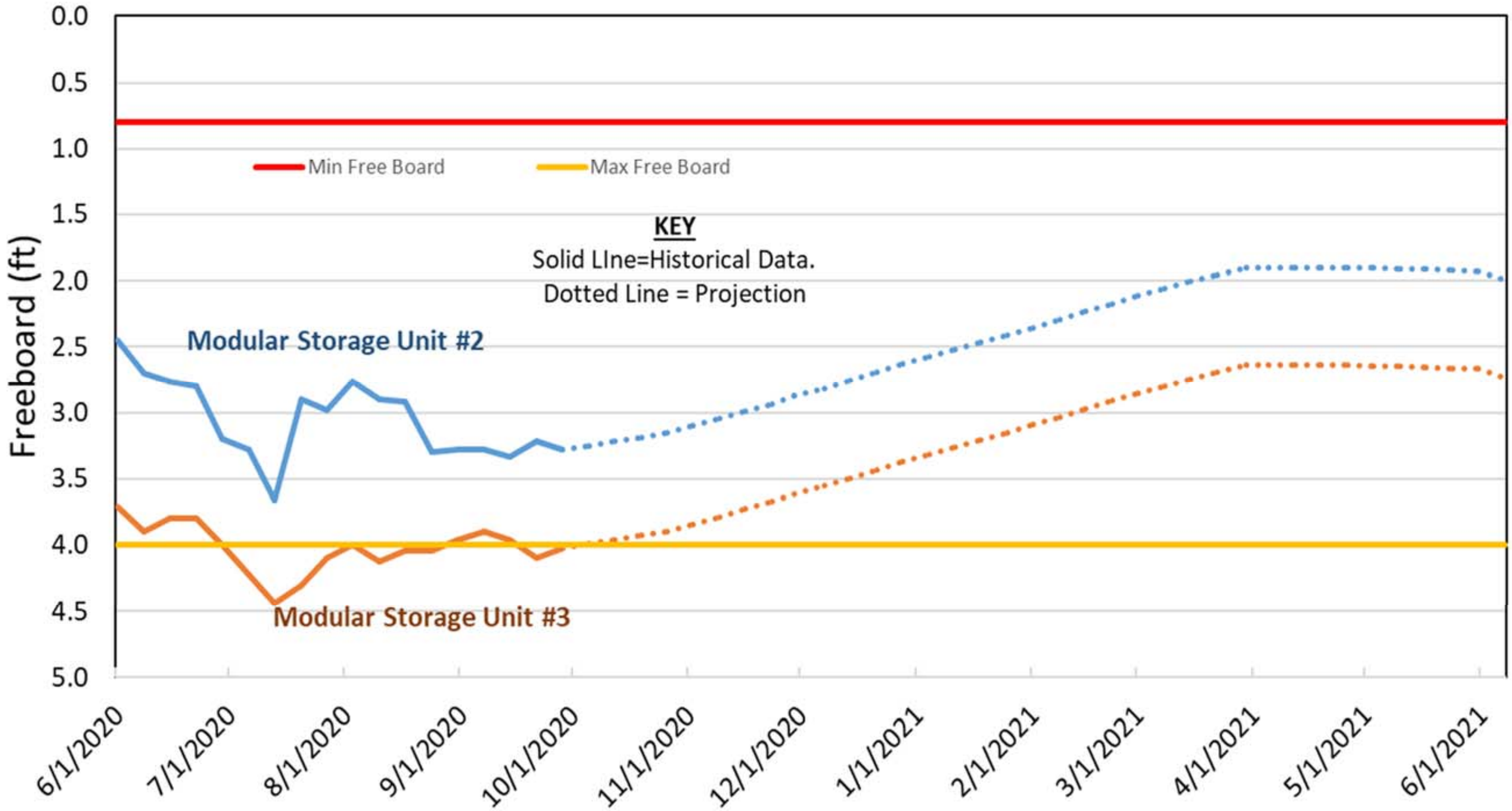


Figure 3. Freeboard in Modular Storage Unit Tanks

The transfer rate from the MSU tanks will need to be carefully controlled to limit process disruptions. In the near term, this flow rate will be controlled manually. The transfer events are expected to be rare in frequency, less than once annually, and short in duration, maybe a week or less. Manual control of flow can be considered in the future if transfers become more frequent or of longer duration.

Based on careful consideration of the information presented, the following recommendations are made:

- Use the existing 10 cm (4 in.) pipeline that was used to transfer MSU water to transfer feed streams originating in the 200 East Area.
- Sample the MSU before transfer and base the actual blend ratio on the concentrations measured.
- For planning purposes, limit blend ratio to less than 76 L/min (20 gal/min).
- Control the flow of MSU water to the transfer tank, manually at first.
- Filter the MSU water with 100 μm pore size filters.
- Add a sample of the ITB2 tank to the monthly compliance sampling.

10 References

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