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R3 Innovations Inc. – Spinghill Lagoons Cell Treatment

Introduction:

R3 Innovations Inc. is governed by Environment Act license 2870 RRR that stipulates the terms and concentrations of discharges permitted by the industrial wastewater treatment facility. As is stipulated in license 2870 RRR and subsequent notices of alteration (NOA) pertaining to the wastewater transfers, all transferred wastewater remains the responsibility of R3 Innovations Inc.

Per clause 3 of the NOA provided by MEC of June 9, 2023, this document provides the detailed treatment plan for the wastewater transferred from R3 Innovations Inc (using the former Springhill facility) to Cell 1 of the Town of Neepawa Municipal treatment system as well as wastewater stored at the Springhill Industrial Wastewater Treatment Facility (SH IWWTF) for review and approval by the director.

Background

The temporary exclusive use of Cell 1 at the Town of Neepawa's municipal facility has been secured by R3 Innovations Inc. for emergency wastewater storage. R3 Innovations has transferred in total approximately 120,000 m^3 of temporarily held HyLife Foods pork processing facility raw effluent from the SH IWWTF , to the town of Neepawa lagoon Cell 1. Wastewater within Cell 1 is the result of 3 distinct transfer events, with the initial event occurring in December of 2021 and the most recent event completed on June 15, 2023.

Wastewater sampling was undertaken by Stantec on May 8, 2023 to estimate the overall wastewater concentration within the town lagoon cell 1.

Table 1: Town Lagoon Cell 1 Wastewater Characteristics (May 8, 2023)

ALS		Sample Location	LAGOON CELL 1
		ALS ID	WP2307083
		Date Sampled	5/8/2023
Analyte	Units	D.L.	Water
pH	pH units	0.1	7.88
Total Suspended Solids	mg/L	3	49.6
Ammonia, Total (as N)	mg/L	0.01	92.3
Un-ionized Ammonia (as N)	mg/L	0.001	1.3
Nitrate and Nitrite as N	mg/L	0.005	<0.112
Nitrate (as N)	mg/L	0.02	<0.1
Nitrite (as N)	mg/L	0.01	<0.05
Total Kjeldahl Nitrogen	mg/L	0.15	95.2
Total Nitrogen	mg/L	0.05	95.2
Phosphorus (P)-Total	mg/L	0.02	15.4
Escherichia Coli	MPN/100mL	1	>2420
Fecal Coliforms	MPN/100mL	1	1010
BOD Carbonaceous	mg/L	2	288
Chemical Oxygen Demand	mg/L	10	593
BOD5	mg/L	2	348

Notes:
- Sample gathered by Stantec
- Composite sample comprised of grab samples taken from multiple locations at various depths throughout the lagoon cell

At current state, R3 Innovations is still amid an upset condition at the R3 Innovations Industrial Wastewater Treatment Facility (R3 IWWTF) and the primary short-term goal is to create additional storage capacity for untreated effluent should additional space be required. Wastewater storage is occurring at the town of Neepawa Cell 1 as well as the SH IWWTF and for emergency purposes, additional capacity at either facility would provide the operational redundancy required. Table 2 provides a characterization of the stored effluent in cell 3 of the SH IWWTF from sampling conducted by R3 Innovations staff on July 20, 2023:

Table 2: SH IWWTF Cell 3 Wastewater Characteristics (July 20, 2023)

	TSS	pH	COD (mg/L)	NH3-N (mg/L)	TN (mg/l)	TP(mg/L)
Springhill Lagoon Cell 3	960	7.04	1830	165	190	18.92

Treatment Strategy Development

Based on overall wastewater volume stored and the concentration of wastewater constituents, a number of treatment alternatives were considered and examined by R3 Innovations Inc.'s consultants including:

- The use of a temporary/mobile membrane treatment system
- Full cell in-situ treatment (town lagoon cell 1)
- Segregation of town lagoon Cell 1 and in-situ treatment similar to a sequenced batch reactor (SBR)
- Similar segregation of SH IWWTF cell 3 and in-situ treatment with batch transfers to other SH IWWTF cells
- Implementation of an SBR treatment utilizing the SH IWWTF cell 2A and associated infrastructure with discharge through R3 Innovations final discharge line
- Transfer to another facility for treatment

A variety of discharge scenarios were also considered including:

- direct discharge from town lagoon Cell 1 to the Whitemud River after full in-situ treatment or by batches following in-situ SBR treatment
- discharge to the Whitemud river via the existing R3 IWWTF outfall after in-situ batch treatment at the SH IWWTF and blending, in-line, with R3 IWWTF effluent
- discharge to the Town of Neepawa municipal system (town lagoon Cell 3) after in-situ treatment, with eventual discharge to the Whitemud River
- transfer of in-situ treated wastewater at the town of Neepawa Cell 1 back to the wetland receiving the R3 IWWTF effluent just before discharge to the Whitemud River, and others.

Each of the above options was evaluated based on a number of factors including cost, feasibility, implementation timeline, and effluent quality.

Proposed Treatment Strategy

Based on R3 Innovation's review of the alternatives with consideration of the above factors, the selected treatment strategy proposed consists of short-term immediate treatment of the wastewater stored at the SH IWWTF and subsequent temporary deployment of treatment equipment to the town lagoon Cell 1 (or transfer of the wastewater stored in town lagoon Cell 1 to the SH IWWTF) to conduct treatment of the wastewater stored there after short-term treatment at the SH IWWTF is completed.

Description of treatment at SH IWWTF:

The existing SH IWWTF cell 2A infrastructure would be used as an SBR to treat batches of stored wastewater from SH IWWTF Cell 3. The SBR-treated wastewater batches would be discharged to the Whitemud River via the existing R3 Innovations final discharge point once the quality of the combination of the SBR and R3 IWWTF effluents are determined to be able to comply with the R3 Innovations Inc 2870 RRR licence limits. The design of the SBR treatment system and the discharge quality and rates will be managed to maintain the total nutrient loading (TN and TP) to the river from R3 innovations and the SH IWWTF within the limits of the R3 Innovations licence limits (2290 m^3/d with a TN of 15 mg/L and a TP of 1 mg/L). Criteria associated with the concentrations related to TSS, BOD5, and ammonia will be managed through the R3 Innovations Inc license as well. E. coli and total/fecal coliforms will also be addressed through the use of sodium hypochlorite addition to disinfect the effluent prior to discharge from Cell 2A to the cell 1 and combination with the R3 Innovations wastewater stream and eventual transfer to the Whitemud River. Chlorine residual values will be tested prior to discharge and sodium thiosulfate will be added should additional chlorine precipitation be required to meet the 0.02 mg/L residual chlorine limit as per the CCME guidelines for wastewater treatment facilities below 5000 m^3/day discharge. The current final effluent composite sampler will be moved to a location further downstream in the R3 IWWTF discharge line to facilitate sampling (Figure 2) of the combined effluent and document compliance with the R3 Innovations Inc licence 2870 RRR discharge criteria.

Proposed Treatment Design

The SBR will be created by use the existing SH IWWTF Cell 2A (Figure 1) as a treatment zone. This treatment zone will be approximately 6000 m^3 in volume. The use of the of Cell 2A allows for a dedicated batch treatment of a manageable wastewater volume that can be treated and discharged. Approximately 4-5 surface aerators will be placed within the treatment zone in a configuration that will provide effective oxygen transfer and nitrification to the sequestered wastewater. The exact number and configuration of the aerators will be determined through further design.

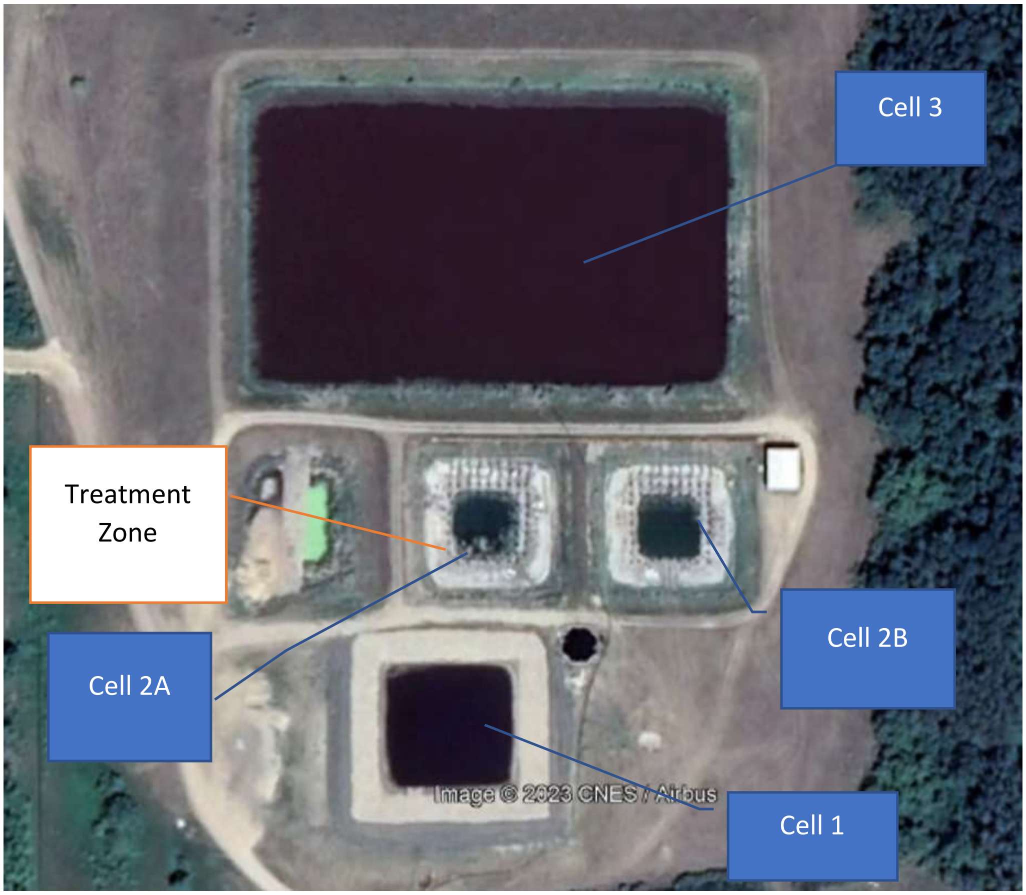

Figure 1:Proposed Treatment Design

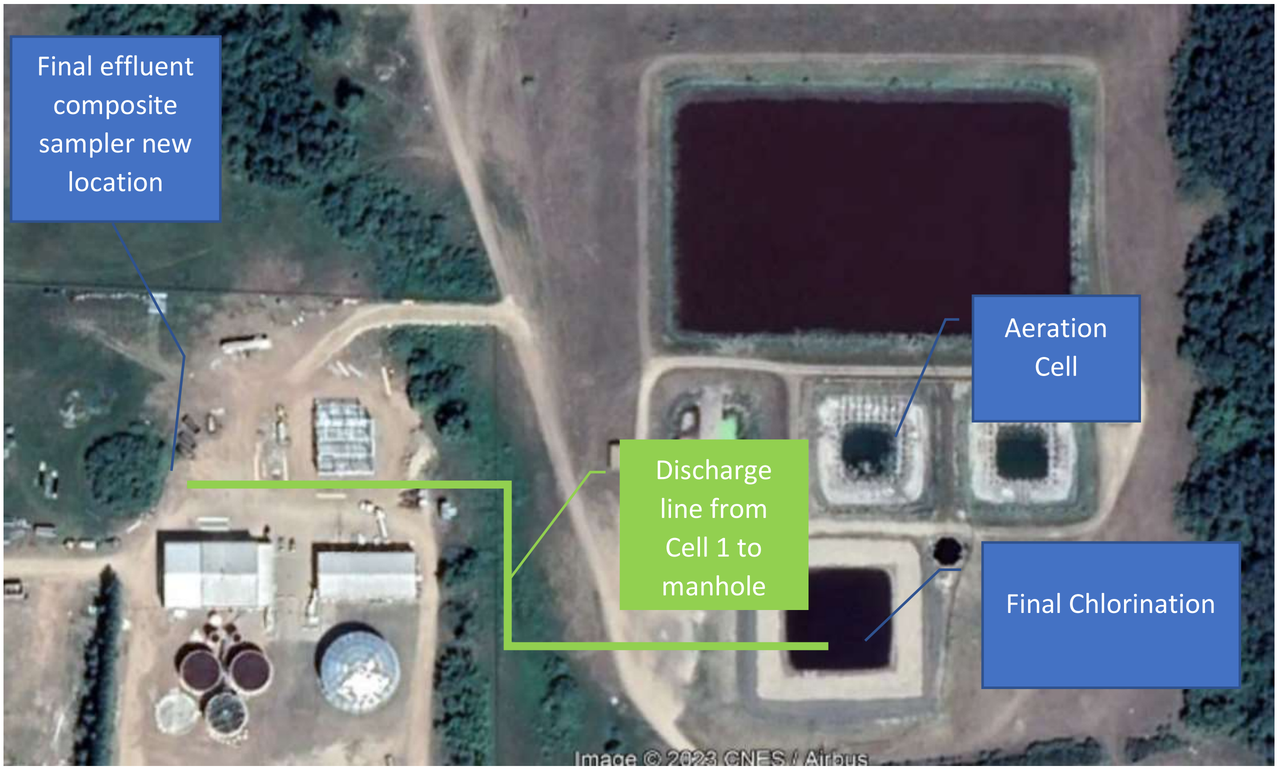

Figure 2: Discharge from SH IWWTF Cell 1to manhole linked to existing R3 Innovations discharge line

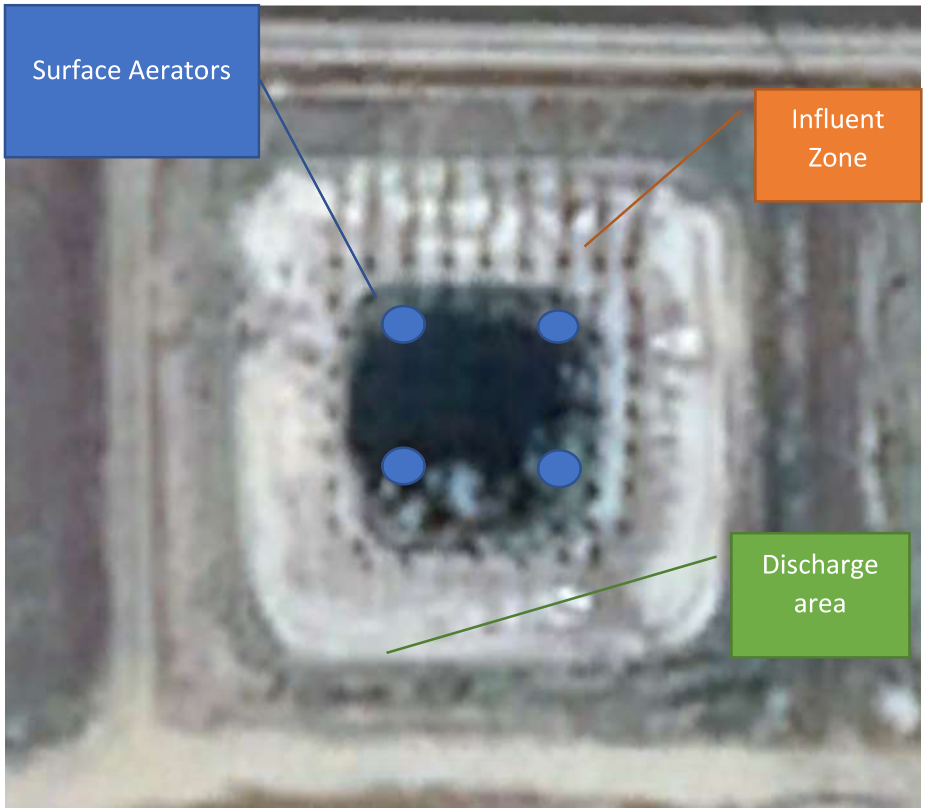

Figure 3: SBR Treatment Zone in Cell 2A.

Figures 2 and 3 provide visuals of the proposed discharge to the existing manhole at R3 Innovations and the SBR (Cell 2A) aerator configuration respectively. Treated effluent from SH IWWTF Cell 2A will be pumped into SH IWWTF Cell 1 for disinfection via sodium hypochlorite injection prior to discharge to a manhole connected to the R3 IWWTF discharge line.

The treatment zone (SH IWWTF cell 2A) will be seeded with seed sludge from the R3 Innovations facility to increase the development of beneficial bacteria and reduce the overall timing to achieve treatment objectives. Treatment zone aeration will be intermittent, creating oxygenated and anoxic conditions within the treatment zone for the encouragement of nitrification/denitrification processes.

Aeration within the treatment zone will be utilized until such time as the majority of the ammonia is nitrified. It is expected that total ammonia-N concentrations in the effluent stream will be below 3 mg/L once the nitrification has been completed. Aerators will be turned off once ammonia-N levels are reduced below 3 mg/L so as to allow for denitrification to take place. Based on the wastewater characterization, it is anticipated that sufficient COD is available within the wastewater to facilitate denitrification (a supplemental carbon source is not expected to be required to augment this process). During the non-aerated period, 2-3, 7.5 horsepower mixers will be employed to sufficiently mix the treatment zone allowing for denitrification of the wastewater.

At the onset of the non-aerated period, ferric chloride will be added to Cell 2A by a chemical dosing pump near one of the mixers to promote dispersal throughout the treatment zone. Ferric chloride is a flocculant utilized in wastewater treatment to precipitate water bound solids and phosphorus. Once fully mixed, the mixers will be shut down to allow for settling within the treatment zone and precipitation of TSS and phosphorus in the floc. The quantity of ferric chloride required to perform this activity will be determined during the setup of the treatment process.

Discharge from SH IWWTF Cell 2A to SH IWWTF Cell 1 will take place utilizing a typical centrifugal pump that will draw wastewater from the surface of the treatment zone (to reduce TSS discharged to the Cell 1). Once disinfected in Cell 1, the effluent will be allowed to dechlorinate (or will be dechlorinated using sodium thiosulfate, as described above) prior to discharge to a manhole along the R3 IWWTF effluent discharge line, combining with the existing R3 Innovations discharge prior to discharge to the Whitemud River. Upon completion of the batch discharge, new, untreated wastewater will be transferred into Cell 2A and the process will begin again once wastewater level in the cell reaches the appropriate operating depth.

Treatment Timeline:

The initial stage leading up to the initialization of treatment is anticipated to be 4-6 weeks. This 4-6 week timeframe will include the lead time for procuring equipment, installation, seeding and tuning of the SBR treatment system. Upon completion of installation and commissioning, initial treatment processes will occur over a period of approximately 10 days following equipment installation and aeration of the treatment zone. The proposed schedule is summarized in Table 3.

Table 3: Proposed 2023 Treatment System Schedule

Activity	Start Date	Completion Date	Days
Procurement and installation of equipment	25-Jul-23	24-Aug-23	30
Startup and Commissioning	24-Aug-23	3-Sep-23	10
Initial Treatment Stage	3-Sep-23	10-Sep-23	7
Daily Discharge Period*	10-Sep-23	14-Oct-23	34

* timing for this stage will be subject to ambient temperatures

Treatment timeline as indicated above will vary depending on multiple factors related to equipment procurement, installation timing, weather conditions, and startup.

R3 Innovations will deposit seed sludge (approximately 100-300 m^3 of waste activated sludge from the R3 Innovations IWWTF suited to denitrification) to the treatment zone in the SH IWWTF Cell 2A via pipeline, to improve startup conditions and encourage a rapid progression to treatment stages. The quantity of seed sludge may vary depending on the biomass development and growth within the treatment zone with adjustments being made based on the mixed liquor suspended solids (MLSS) content within the treatment zone. An MLSS content of approximately 2000-3000 mg/L is anticipated to be the preferred concentration, to be adjusted pending sampling results and treatment performance. Maintenance of this mixed liquor content will be managed through weekly wasting of waste activated sludge to the cell 3 of the SH IWWTF (to be managed via a future sludge disposal program). Frequency and quantity of wasting will be determined based on system operation parameters and performance but is anticipated to occur 1-3 times per week depending on quality and corresponding characteristics of the R3 IWWTF effluent.

Following the initial discharge cycle, aeration is anticipated to be conducted on a daily basis typically from 8 am to 3-5 pm with subsequent denitrification occurring in the evenings and overnight. Specific timing of the aeration and denitrification cycles will be adjusted based on system performance and sample results. Once operational, it is anticipated that treatment will occur on a consistent basis at a rate of 350-600 m^3/day for transfer into the R3 IWWTF effluent line and final discharge to receiving wetland prior to flowing to the Whitemud River.

Treated Wastewater Quality:

The anticipated wastewater discharge concentrations from the SBR treatment cell (SH IWWTF Cell 1) to the R3 Innovations final discharge line are displayed in Table 4. These would be considered maximum SBR wastewater concentration criteria.

Table 4: SBR Treatment Criteria

Expected Discharge - Cell 2A SBR						
	TSS	pH	BOD (mg/L)	NH3-N (mg/L)	TN (mg/l)	TP(mg/L)
SBR Discharge	<50	7.5	<25	<3	<50	<3

Expected effluent flows from the SBR system will be based upon the overall treatment level achieved as well as discharge quantity and quality from the R3 Innovations IWWTF. Combined flows are intended to be discharged while maintaining R3 Innovations license 2870 RRR discharge criteria. Table 5 provides a brief overview of the combined flow calculations that are being utilized, using the anticipated discharge averages for R3 Innovations over the past year as well as expected treatment criteria from the SBR to be confirmed via composite sampling of the combined discharge stream.

Table 5: Example Discharge Calculations for R3 IWWTF and SBR Treatment

	Volume (m3/day)	TN (mg/L)	Unionized Ammonia (NH3-N) mg/L *	Total Ammonia (NH3-N + NH4-N) mg/L *	TP (mg/L)	TSS (mg/L)	BOD₅ (mg/L	e. coli (mpn/100 ml)	fecal coliforms (mpn/100 ml)
License Limits	2290	15		17.03	1	25	25	200	200
R3 Effluent Avg Jan-M	1650	6.53	0.001	0.065	0.19	1.3	2	5	5
Remaining volume	640								
Proposed SBR Discharge Limits		**50**	**0.022**	**3**	**3**	**50**	**25**	200	200

* unionized ammonia for SBR estimated based on total ammonia at a pH of 7.6 (conc from sched 1 of EAL 2870 RRR) and temperature of 10 deg C, R3 estimated at pH of 7.6 and temp of 25 deg C

SBR Discharge: SBR Discharge Volume (m3/day)	SBR Discharge: Total N (kg/day)	SBR Discharge: Unionized Ammonia (NH3-N kg/day)	SBR Discharge: Total Ammonia (NH3-N + NH4-N) kg/day	SBR Discharge: Total P (kg/day)	SBR Discharge: TSS (kg/day)	SBR Discharge: BOD (kg/day)	R3 Innovations Discharge: R3 Innov Discharge Volume (m3/day)	R3 Innovations Discharge: Total N (kg/day)	R3 Innovations Discharge: Unionized Ammonia (NH3-N kg/day)	R3 Innovations Discharge: Total Ammonia (NH3-N + NH4-N) kg/day	R3 Innovations Discharge: Total P (kg/day)	R3 Innovations Discharge: TSS (kg/day)	R3 Innovations Discharge: BOD (kg/day)
License Limit													
100	5.0	0.00220	0.300	0.300	5.000	2.50	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
150	7.5	0.00330	0.450	0.450	7.500	3.75	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
200	10.0	0.00440	0.600	0.600	10.000	5.00	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
250	12.5	0.00550	0.750	0.750	12.500	6.25	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
300	15.0	0.00660	0.900	0.900	15.000	7.50	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
350	17.5	0.0077[illegible]	1.050	1.050	17.500	8.75	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
400	20.0	0.00880	1.200	1.200	20.000	10.00	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
450	22.5	0.00990	1.350	1.350	22.500	11.25	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
500	25.0	0.01100	1.500	1.500	25.000	12.50	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
550	27.5	0.01210	1.650	1.650	27.500	13.75	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
600	30.0	0.01320	1.800	1.800	30.000	15.00	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
650	32.5	0.01430	1.950	1.950	32.500	16.25	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
700	35.0	0.01540	2.100	2.100	35.000	17.50	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
750	37.5	0.01650	2.250	2.250	37.500	18.75	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
800	40.0	0.01760	2.400	2.400	40.000	20.00	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
850	42.5	0.01870	2.550	2.550	42.500	21.25	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
900	45.0	0.01980	2.700	2.700	45.000	22.50	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
950	47.5	0.02090	2.850	2.850	47.500	23.75	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
1000	50.0	0.02200	3.000	3.000	50.000	25.00	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
1050	52.5	0.02310	3.150	3.150	52.500	26.25	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
1100	55.0	0.02420	3.300	3.300	55.000	27.50	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
1150	57.5	0.02530	3.450	3.450	57.500	28.75	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
1200	60.0	0.02640	3.600	3.600	60.000	30.00	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
1250	62.5	0.02750	3.750	3.750	62.500	31.25	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
1300	65.0	0.02860	3.900	3.900	65.000	32.50	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
1350	67.5	0.02970	4.050	4.050	67.500	33.75	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
1400	70.0	0.03080	4.200	4.200	70.000	35.00	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
1450	72.5	0.03190	4.350	4.350	72.500	36.25	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30

SBR Discharge Volume (m3/day)	Virtual Combined Discharge – Loading: Total Combined R3 and SBR Discharge Volume	Loading: Total N (kg/day)	Loading: Unionized Ammonia (NH3-N kg/day)	Loading: Total Ammonia (NH3-N + NH4-N) kg/day	Loading: Total P (kg/day)	Loading: TSS (kg/day)	Loading: BOD (kg/day)	Concentration **: Total N Concentration (mg/L)	Concentration **: Total P Concentration (mg/L)	Concentration **: Unionized Ammonia (NH3-N mg/L)	Concentration **: Total Ammonia (NH3-N + NH4-N) mg/L *	Concentration **: TSS (mg/L	Concentration **: BOD (mg/L)	First Limiting Parameter
License Limit	2290.0	34.4		39.0	2.3	57.3	57.3	15.00	1.00		17.03	25.0	25.0	
100	1750.00	15.77	0.0039	0.41	0.61	7.15	5.80	9.01	0.35	0.0022	0.233	4.1	3.3	#N/A
150	1800.00	18.27	0.0050	0.56	0.76	9.65	7.05	10.15	0.42	0.0028	0.310	5.4	3.9	#N/A
200	1850.00	20.77	0.0061	0.71	0.91	12.15	8.30	11.23	0.49	0.0033	0.382	6.6	4.5	#N/A
250	1900.00	23.27	0.0072	0.86	1.06	14.65	9.55	12.25	0.56	0.0038	0.451	7.7	5.0	#N/A
300	1950.00	25.77	0.0083	1.01	1.21	17.15	10.80	13.22	0.62	0.0042	0.517	8.8	5.5	#N/A
350	2000.00	28.27	0.0094	1.16	1.36	19.65	12.05	14.14	0.68	0.0047	0.579	9.8	6.0	#N/A
400	2050.00	30.77	0.0105	1.31	1.51	22.15	13.30	15.01	0.74	0.0051	0.638	10.8	6.5	Total N Concentration (mg/L)
450	2100.00	33.27	0.0116	1.46	1.66	24.65	14.55	15.85	0.79	0.0055	0.694	11.7	6.9	Total N Concentration (mg/L)
500	2150.00	35.77	0.0127	1.61	1.81	27.15	15.80	16.64	0.84	0.0059	0.748	12.6	7.3	Total N (kg/day)
550	2200.00	38.27	0.0138	1.76	1.96	29.65	17.05	17.40	0.89	0.0063	0.799	13.5	7.8	Total N (kg/day)
600	2250.00	40.77	0.0149	1.91	2.11	32.15	18.30	18.12	0.94	0.0066	0.848	14.3	8.1	Total N (kg/day)
650	2300.00	43.27	0.0160	2.06	2.26	34.65	19.55	18.82	0.98	0.0069	0.894	15.1	8.5	Total Combined R3 and SBR Discharge Volume
700	2350.00	45.77	0.0171	2.21	2.41	37.15	20.80	19.48	1.03	0.0073	0.939	15.8	8.9	Total Combined R3 and SBR Discharge Volume
750	2400.00	48.27	0.0182	2.36	2.56	39.65	22.05	20.11	1.07	0.0076	0.982	16.5	9.2	Total Combined R3 and SBR Discharge Volume
800	2450.00	50.77	0.0193	2.51	2.71	42.15	23.30	20.72	1.11	0.0079	1.023	17.2	9.5	Total Combined R3 and SBR Discharge Volume
850	2500.00	53.27	0.0204	2.66	2.86	44.65	24.55	21.31	1.15	0.0081	1.063	17.9	9.8	Total Combined R3 and SBR Discharge Volume
900	2550.00	55.77	0.0215	2.81	3.01	47.15	25.80	21.87	1.18	0.0084	1.101	18.5	10.1	Total Combined R3 and SBR Discharge Volume
950	2600.00	58.27	0.0226	2.96	3.16	49.65	27.05	22.41	1.22	0.0087	1.137	19.1	10.4	Total Combined R3 and SBR Discharge Volume
1000	2650.00	60.77	0.0237	3.11	3.31	52.15	28.30	22.93	1.25	0.0089	1.173	19.7	10.7	Total Combined R3 and SBR Discharge Volume
1050	2700.00	63.27	0.0248	3.26	3.46	54.65	29.55	23.44	1.28	0.0092	1.206	20.2	10.9	Total Combined R3 and SBR Discharge Volume
1100	2750.00	65.77	0.0259	3.41	3.61	57.15	30.80	23.92	1.31	0.0094	1.239	20.8	11.2	Total Combined R3 and SBR Discharge Volume
1150	2800.00	68.27	0.0270	3.56	3.76	59.65	32.05	24.38	1.34	0.0096	1.270	21.3	11.4	Total Combined R3 and SBR Discharge Volume
1200	2850.00	70.77	0.0281	3.71	3.91	62.15	33.30	24.83	1.37	0.0098	1.301	21.8	11.7	Total Combined R3 and SBR Discharge Volume
1250	2900.00	73.27	0.0292	3.86	4.06	64.65	34.55	25.27	1.40	0.0101	1.330	22.3	11.9	Total Combined R3 and SBR Discharge Volume
1300	2950.00	75.77	0.0303	4.01	4.21	67.15	35.80	25.69	1.43	0.0103	1.358	22.8	12.1	Total Combined R3 and SBR Discharge Volume
1350	3000.00	78.27	0.0314	4.16	4.36	69.65	37.05	26.09	1.45	0.0105	1.386	23.2	12.4	Total Combined R3 and SBR Discharge Volume
1400	3050.00	80.77	0.0325	4.31	4.51	72.15	38.30	26.48	1.48	0.0106	1.412	23.7	12.6	Total Combined R3 and SBR Discharge Volume
1450	3100.00	83.27	0.0336	4.46	4.66	74.65	39.55	26.86	1.50	0.0108	1.438	24.1	12.8	Total Combined R3 and SBR Discharge Volume

* assumes effluent pH of 7.6 from Schedule 1 of EAL 2870 RRR pursuant to clause 35 (g)

** Not valid for separate effluent discharges, assumes that both R3 and SBR discharges are combined into the same effluent prior to discharge to Whitemud River. Does not consider that SBR is discharged to the Town Lagoon Cell 3 prior to discharge to Whitemud, and separate from R3's discharge to wetland prior to discharge to Whitemud

As seen in Table 5, based on proposed SBR discharge concentrations, the limiting criteria for discharge would be the combined Total Nitrogen loading concentration. The SBR discharge in this scenario would be limited to 350 m^3/day (highlighted in yellow) to maintain the combined quality of the two wastewater treatment systems (effluent from the R3 IWWTF and the SBR treatment zone within Cell 2A) within the total R3 Innovations Inc. discharge limits. As shown within the table, the remaining criteria would be below discharge limits as per licenses 2870 RRR.

Table 6 describes the maximum potential discharge based on a potentially improved treatment capacity within the SBR system. In this scenario, TN is treated to 35 mg/L in the SBR treatment zone and phosphorus maintains at a level of 3.0 mg/L. In this scenario, the total discharge allowable is 2290 m^3/day which is the volumetric limit as dictated in license 2870 RRR (highlighted in yellow).

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Table 6: Discharge Scenario with Improved SBR Performance

	Volume (m3/day)	TN (mg/L)	Unionized Ammonia (NH3-N) mg/L *	Total Ammonia (NH3-N + NH4-N) mg/L *	TP (mg/L)	TSS (mg/L)	BOD5 (mg/L	e. coli (mpn/100 ml)	fecal coliforms (mpn/100 ml)
License Limits	2290	15		17.03	1	25	25	200	200
R3 Effluent Avg Jan-N	1650	6.53	0.001	0.065	0.19	1.3	2	5	5
Remaining volume	640								
Proposed SBR Discharge Limits		35	0.022	3	3	50	25	200	200

* unionized ammonia for SBR estimated based on total ammonia at a pH of 7.6 (conc from sched 1 of EAL 2870 RRR) and temperature of 10 deg C, R3 estimated at pH of 7.6 and temp of 25 deg C

SBR Discharge							R3 Innovations Discharge						
SBR Discharge Volume (m3/day)	Total N (kg/day)	Unionized Ammonia (NH3-N kg/day)	Total Ammonia (NH3-N + NH4-N) kg/day	Total P (kg/day)	TSS (kg/day)	BOD (kg/day)	R3 Innov Discharge Volume (m3/day)	Total N (kg/day)	Unionized Ammonia (NH3-N kg/day)	Total Ammonia (NH3-N + NH4-N) kg/day	Total P (kg/day)	TSS (kg/day)	BOD (kg/day)
License Limit													
100	3.5	0.00220	0.300	0.300	5.000	2.50	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
150	5.3	0.00330	0.450	0.450	7.500	3.75	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
200	7.0	0.00440	0.600	0.600	10.000	5.00	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
250	8.8	0.00550	0.750	0.750	12.500	6.25	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
300	10.5	0.00660	0.900	0.900	15.000	7.50	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
350	12.3	0.00770	1.050	1.050	17.500	8.75	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
400	14.0	0.00880	1.200	1.200	20.000	10.00	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
450	15.8	0.00990	1.350	1.350	22.500	11.25	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
500	17.5	0.01100	1.500	1.500	25.000	12.50	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
550	19.3	0.01210	1.650	1.650	27.500	13.75	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
600	21.0	0.01320	1.800	1.800	30.000	15.00	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
650	22.8	0.01430	1.950	1.950	32.500	16.25	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
700	24.5	0.01540	2.100	2.100	35.000	17.50	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
750	26.3	0.01650	2.250	2.250	37.500	18.75	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
800	28.0	0.01760	2.400	2.400	40.000	20.00	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
850	29.8	0.01870	2.550	2.550	42.500	21.25	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
900	31.5	0.01980	2.700	2.700	45.000	22.50	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
950	33.3	0.02090	2.850	2.850	47.500	23.75	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
1000	35.0	0.02200	3.000	3.000	50.000	25.00	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
1050	36.8	0.02310	3.150	3.150	52.500	26.25	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
1100	38.5	0.02420	3.300	3.300	55.000	27.50	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
1150	40.3	0.02530	3.450	3.450	57.500	28.75	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
1200	42.0	0.02640	3.600	3.600	60.000	30.00	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
1250	43.8	0.02750	3.750	3.750	62.500	31.25	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
1300	45.5	0.02860	3.900	3.900	65.000	32.50	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
1350	47.3	0.02970	4.050	4.050	67.500	33.75	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
1400	49.0	0.03080	4.200	4.200	70.000	35.00	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30
1450	50.8	0.03190	4.350	4.350	72.500	36.25	1650.00	10.77	0.0017	0.11	0.31	2.15	3.30

	Virtual Combined Discharge													
	Loading							Concentration **						
SBR Discharge Volume (m3/day)	Total Combined R3 and SBR Discharge Volume	Total N (kg/day)	Unionized Ammonia (NH3-N kg/day)	Total Ammonia (NH3-N + NH4-N) kg/day	Total P (kg/day)	TSS (kg/day)	BOD (kg/day)	Total N Concentration (mg/L)	Total P Concentration (mg/L)	Unionized Ammonia (NH3-N mg/L)	Total Ammonia (NH3-N + NH4-N) mg/L *	TSS (mg/L	BOD (mg/L)	First Limiting Parameter
License Limit	2290.0	34.4		39.0	2.3	57.3	57.3	15.00	1.00		17.03	25.0	25.0	
100	1750.00	14.27	0.0039	0.41	0.61	7.15	5.80	8.16	0.35	0.0022	0.233	4.1	3.3	#N/A
150	1800.00	16.02	0.0050	0.56	0.76	9.65	7.05	8.90	0.42	0.0028	0.310	5.4	3.9	#N/A
200	1850.00	17.77	0.0061	0.71	0.91	12.15	8.30	9.61	0.49	0.0033	0.382	6.6	4.5	#N/A
250	1900.00	19.52	0.0072	0.86	1.06	14.65	9.55	10.28	0.56	0.0038	0.451	7.7	5.0	#N/A
300	1950.00	21.27	0.0083	1.01	1.21	17.15	10.80	10.91	0.62	0.0042	0.517	8.8	5.5	#N/A
350	2000.00	23.02	0.0094	1.16	1.36	19.65	12.05	11.51	0.68	0.0047	0.579	9.8	6.0	#N/A
400	2050.00	24.77	0.0105	1.31	1.51	22.15	13.30	12.09	0.74	0.0051	0.638	10.8	6.5	#N/A
450	2100.00	26.52	0.0116	1.46	1.66	24.65	14.55	12.63	0.79	0.0055	0.694	11.7	6.9	#N/A
500	2150.00	28.27	0.0127	1.61	1.81	27.15	15.80	13.15	0.84	0.0059	0.748	12.6	7.3	#N/A
550	2200.00	30.02	0.0138	1.76	1.96	29.65	17.05	13.65	0.89	0.0063	0.799	13.5	7.8	#N/A
600	2250.00	31.77	0.0149	1.91	2.11	32.15	18.30	14.12	0.94	0.0066	0.848	14.3	8.1	#N/A
650	2300.00	33.52	0.0160	2.06	2.26	34.65	19.55	14.58	0.98	0.0069	0.894	15.1	8.5	Total Combined R3 and SBR Discharge Volume
700	2350.00	35.27	0.0171	2.21	2.41	37.15	20.80	15.01	1.03	0.0073	0.939	15.8	8.9	Total Combined R3 and SBR Discharge Volume
750	2400.00	37.02	0.0182	2.36	2.56	39.65	22.05	15.43	1.07	0.0076	0.982	16.5	9.2	Total Combined R3 and SBR Discharge Volume
800	2450.00	38.77	0.0193	2.51	2.71	42.15	23.30	15.83	1.11	0.0079	1.023	17.2	9.5	Total Combined R3 and SBR Discharge Volume
850	2500.00	40.52	0.0204	2.66	2.86	44.65	24.55	16.21	1.15	0.0081	1.063	17.9	9.8	Total Combined R3 and SBR Discharge Volume
900	2550.00	42.27	0.0215	2.81	3.01	47.15	25.80	16.58	1.18	0.0084	1.101	18.5	10.1	Total Combined R3 and SBR Discharge Volume
950	2600.00	44.02	0.0226	2.96	3.16	49.65	27.05	16.93	1.22	0.0087	1.137	19.1	10.4	Total Combined R3 and SBR Discharge Volume
1000	2650.00	45.77	0.0237	3.11	3.31	52.15	28.30	17.27	1.25	0.0089	1.173	19.7	10.7	Total Combined R3 and SBR Discharge Volume
1050	2700.00	47.52	0.0248	3.26	3.46	54.65	29.55	17.60	1.28	0.0092	1.206	20.2	10.9	Total Combined R3 and SBR Discharge Volume
1100	2750.00	49.27	0.0259	3.41	3.61	57.15	30.80	17.92	1.31	0.0094	1.239	20.8	11.2	Total Combined R3 and SBR Discharge Volume
1150	2800.00	51.02	0.0270	3.56	3.76	59.65	32.05	18.22	1.34	0.0096	1.270	21.3	11.4	Total Combined R3 and SBR Discharge Volume
1200	2850.00	52.77	0.0281	3.71	3.91	62.15	33.30	18.52	1.37	0.0098	1.301	21.8	11.7	Total Combined R3 and SBR Discharge Volume
1250	2900.00	54.52	0.0292	3.86	4.06	64.65	34.55	18.80	1.40	0.0101	1.330	22.3	11.9	Total Combined R3 and SBR Discharge Volume
1300	2950.00	56.27	0.0303	4.01	4.21	67.15	35.80	19.08	1.43	0.0103	1.358	22.8	12.1	Total Combined R3 and SBR Discharge Volume
1350	3000.00	58.02	0.0314	4.16	4.36	69.65	37.05	19.34	1.45	0.0105	1.386	23.2	12.4	Total Combined R3 and SBR Discharge Volume
1400	3050.00	59.77	0.0325	4.31	4.51	72.15	38.30	19.60	1.48	0.0106	1.412	23.7	12.6	Total Combined R3 and SBR Discharge Volume
1450	3100.00	61.52	0.0336	4.46	4.66	74.65	39.55	19.85	1.50	0.0108	1.438	24.1	12.8	Total Combined R3 and SBR Discharge Volume

* assumes effluent pH of 7.6 from Schedule 1 of EAL 2870 RRR pursuant to clause 35 (g)

** Not valid for separate effluent discharges, assumes that both R3 and SBR discharges are combined into the same effluent prior to discharge to Whitemud River. Does not consider that SBR is discharged to the Town Lagoon Cell 3 prior to discharge to Whitemud, and separate from R3's discharge to wetland prior to discharge to Whitemud

Based on the previously described scenarios, treatment duration will range from approximately 58 treatment days to 100 treatment days depending on treatment efficiency within the SBR system. Temperature plays a critical role in the treatment process with the processes of nitrification and denitrification slowing considerably when ambient water temperatures go below 10 deg Celsius. Based on temperature estimates, there would be approximately 41 potential days remaining in 2023 for treatment (temperature dependent and could extend with mild fall temperatures) allowing for 14,350 m^3 to 24,600 m^3 of the SH IWWTF-stored wastewater to be treated by the end of 2023, providing additional emergency discharge volume should R3 Innovations require it during the continued recovery period. The remaining volume of approximately 10,400-22,650 m^3 of untreated wastewater in the SH IWWTF would have to be treated in 2024 (in addition to the stored effluent in the town of Neepawa municipal cell 1). Based on these estimates, the remaining wastewater in the SH IWWTF should be completely treated in 17-59 treatment days (assuming no additional upset deposits). This would have an approximate treatment end date ranging from spring 2024 to summer 2024.

Post complete treatment of all stored wastewater at the SH IWWTF, wastewater stored in municipal cell 1 will be treated in a similar fashion, utilizing an SBR, with combined effluent loading to the Whitemud River maintained within existing R3 Innovations Inc. license limits. Two scenarios are potential options for this future treatment:

1. Wastewater Transfer – conduct transfers of the stored wastewater from town lagoon Cell 1 back to the SH IWWTF for treatment using the subject proposed treatment system.
2. Equipment transfer from the SH IWWTF proposed SBR system to a sequestered portion of the existing town lagoon Cell 1 to operate in the same fashion as described in the above plan.

Future evaluations will be conducted to further qualify the validity of both of these options and will be presented to Manitoba Environment and Climate prior to initiation of any further changes. It is anticipated this will be understood by spring of 2024. Continued use of the SH IWWTF and town lagoon system, and employment of future SBR treatment of stored effluent when storage quantities go beyond R3 Innovations treatment capacity will be deployed as a long term upset condition mitigation measure for the R3 Innovations facility. The use of the SH IWWTF and the option to lease cell 1 of the town of Neepawa municipal lagoon system will provide significant redundancy and emergency storage for any potential future upset condition events.

Summary

In summary, the implementation of an SBR system, using SH IWWTF Cells 2A and 1 initially and then using Cell 1 in the town of Neepawa municipal lagoon is the proposed method for treating R3 Innovations Inc.'s stored wastewater. It allows for:

- timely startup (4-6 weeks till treatment is initiated)
- emergency discharge – with the timely startup and rapid commissioning to treatment status, it provides an opportunity to create some future emergency storage capacity at the SH IWWTF, should it be required.

- Operations can be managed with internal resources and lab testing equipment at the R3 IWWTF.
- Removable infrastructure
- Minimal impact to existing infrastructure
- Discharge of 350-600 m^3/day

In conclusion, R3 Innovations respectfully requests approval from Manitoba Environment and Climate to initiate the SBR treatment process within the SH IWWTF. Time being of the essence as it would be beneficial to all associated parties to initiate this treatment process within the 2023 calendar year to provide additional redundant storage capacity in case of the need for future additional upset deposits.

Respectfully,

[redacted]

Sheldon Stott
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