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September 19, 2018

City of Iqaluit
Building 901 (City Hall) Nunavut Drive
Iqaluit, NU X0A 0H0

Attention: Matthew Hamp, Department of Engineering and Sustainability

Dear Matthew,

**Reference: Iqaluit Wastewater Treatment System
Existing Sewage Lagoon Performance Review (DRAFT)**

BACKGROUND

Nunami Stantec, in cooperation with the City of Iqaluit, previously prepared the potential timeline and developed an action plan to temporarily divert flow to the existing lagoon to allow the improvements to be implemented to the existing Wastewater Treatment Plant (WWTP). See letter of June 6, 2018. The diversion is necessary as the current Headworks within the WWTP will require a complete shutdown for up to 4 months to replace the existing components with new and improved equipment in order to provide additional capacity to meet the growing needs of the City. A technical review of the lagoon action plan was performed by CIRNAC, in which their comments and recommendations were implemented into the updated action plan (See letter of August 10th, 2018).

A future use of the lagoon was identified more than a decade ago as a provisional treatment process in the event that the wastewater treatment facility needed to be bypassed. This objective remains with a specific requirement for the current project to provide a treatment process during the needed diversion to build the new plant. The intent is also to incorporate the lagoon, as previously intended, as a provisional treatment process in the overall treatment system.

As per the action plan, a test diversion to the lagoon was undertaken and the results of that testing and the sludge survey performed, and the anticipated level of treatment is summarized in this letter.

LAGOON ACTION PLAN UPDATE

The previously prepared Action Plan is updated as follows:

Event	Planned Date	Actual Date
Prepare and Approve Lagoon Action Plan	June 2018	June 2018
Performance Test (two weeks)	July 2018	August 2018
Perform Sludge Survey	August 2018	September 2018
Quantify Anticipated Treatment Results	August 2018	September 2018
Inform Stakeholders	September 2018	September 2018

Event	Planned Date	Actual Date
Install Public Access Deterrents	September 2018	
Divert Flow to Lagoon	October 2018	
Monitor Lagoon	October 2018 to January 2019	
Divert to Newly Commissioned WWTP (Primary Treatment)	January 2019	
Prepare Desludge Documents for Pricing	February 2019	
Obtain Pricing & Award	March 2019	
Shipping of Geotubes	July 2019	
Commence Dewatering of Sludge	August 2019	
Complete Dewatering of Sludge	September 2019	
Decant Lagoon & Evaluate Condition	September 2019	
Prepare Lagoon Operations Manual	October 2019	
Lagoon in Operation for Plant Upset Conditions	October 2019	
WWTP Commissioned (Secondary Treatment)	November 2019	
Geotube Freeze Thaw Dewatering	Winter 2019/2020	
Excavate and Transport Dewatered Solids to Landfill for use as an organic cover material	August 2020	

LAGOON COMPONENTS

Lagoon Characteristics

The available piping systems to the lagoon incorporate a combination septage dump station and diversion chamber which allows both the septage and gravity flow from the City's system to be directed to the lagoon on a provisional basis.

Based on the limited information available, the lagoon volume is reported to be 56,000 m³.

The outlet from the lagoon, based on 1991 as-builts, consists of piped discharge controlled by a valve chamber; the elevation of the discharge is 5.6 metres, which is approximately 2 metres above the bottom of the lagoon. The lagoon is not lined and several features such as a French drain, and an overflow spillway, were incorporated into the design of the lagoon to maintain the geotechnical stability of the system. The discharge point of the outlet directs the flow to the same channel that the current WWTP outfall discharges to.

The lagoon provided successful treatment of sewage for decades, and it is anticipated that it will continue to function as a treatment facility and provide a reasonable level of treatment for the four-month shutdown.

Current Sludge Volume

It is understood that the most recent desludging of the sewage lagoon occurred in 1991. The lagoon remained in full operation until 2006 at which time the mechanical primary treatment system was commissioned at the current WWTP. Since 2006, the lagoon has been utilized for short periods during process upsets at the WWTP.

The sludge survey has been performed and the results are:

- Volume Pond – 20,436 m³
- Volume Sludge – 1,597 m³
- Volumetric Sludge Percentage – 7.8%

LAGOON PERFORMANCE

The testing was undertaken over a 2-week period in July and August. Both the influent and effluent were tested.

Performance Test Results

The results of the recent testing are as follows:

Date	Sample	BOD (mg/L)	TSS (mg/L)
Sewage Lagoon			
July 27, 2018	Influent	134	124
	Effluent	24	58

August 2, 2018	Influent	59	148
	Effluent	33	64
August 7, 2018	Influent	173	176
	Effluent	60	72

SUMMARY - average BOD removal was 64%, while average TSS removal was 57%.

Above presented data shows an average calculated effluent TSS:BOD rate of 1.9, which indicates good lagoon treatment performance. TSS:BOD rates close to 1 indicate poor treatment or short-circuiting, with untreated wastewater mixing with the effluent while rates less than 1 indicate old sludge solubilization and release of soluble BOD. Rates above 2 are due to algal overgrowth and high loss of sludge particles with the effluent.

And in comparison, the most recent results of testing of the Wastewater Treatment Plant are as follows:

Date	Sample	BOD (mg/L)	TSS (mg/L)
Wastewater Treatment Plant			
November 30, 2017	Influent	146	300
	Effluent	151	164
January 24, 2018	Influent	237	244
	Effluent	202	208
March 8, 2018	Influent	223	188
	Effluent	182	168
March 15, 2018	Influent	322	284
	Effluent	300	324

SUMMARY - average BOD removal was 9%, while average TSS removal was 15%.

As seen, the Wastewater Treatment Plant which consists of primary treatment only, has been performing poorly. The sewage lagoon has by far outperformed the WWTP and a much higher level of performance can be anticipated during the diversion.

Theoretical Lagoon Performance

Even though the TSS removal during the winter months when the diversion to the lagoon will be accomplished is expected to be higher than the TSS removal obtained during testing over the summer months, for worst case scenario conditions the TSS average removal of 57% is used to estimate the solids that will stay in the lagoon during a four-month wastewater diversion period. The estimation follows:

Current WWTP Flow to be Diverted to the Lagoon:	3,326 m ³ /day
Influent Wastewater TSS:	149 ppm or g/ m ³ (using the TSS average obtained during summer testing)
Total Influent Solids to lagoon:	497 kg/day
Total Expected Days of Flow Diversion to Lagoon:	120 days
Total Quantity of Solids to be Diverted to Lagoon:	59,602 kg
Estimated TSS Removal Expected:	57% (same obtained during summer testing for worst case scenario)
Solids Expected to Settle in Lagoon for 120 Days:	33,973 kg
Typical Sludge Density:	1,100 kg/m ³
Volume of Solids to Settle in Lagoon for 120 Days:	31 m ³
Total Lagoon Volume from Survey:	20,436 m ³
Current Volume of Solids in Lagoon from Survey:	1,597 m ³
Current Volumetric Solids Percentage in Lagoon:	7.8%
Total Solids Volume in Lagoon after 120 Days:	1,628 m ³
Volumetric Solids Percentage in Lagoon after 120 Days:	8.0%

The estimation shows that the volumetric solids increase in the lagoon over a period of 4 months would be only 0.2% which wouldn't present any issues for the lagoon operation.

The top water elevation registered in the lagoon survey is 5.9 meter. Therefore, the lagoon will be able to receive approximately 0.6 more meters of water depth to reach the maximum water elevation of 6.5 meters registered on the lagoon design drawings. Considering a total lagoon storage volume of approximately 25,000 m³ at maximum water level in the lagoon, the hydraulic retention time could be estimated as follows:

Estimated Total Lagoon Storage Volume:	25,000 m ³
Total Solids Volume in Lagoon after 120 Days:	1,628 m ³
Total Water Volume in Lagoon after 120 Days:	23,372 m ³
Current WWTP Flow to be Diverted to the Lagoon:	3,326 m ³ /day
Lagoon Hydraulic Retention Time (HRT):	7 days.

This HRT is congruent with calculations developed during previous years for the lagoon. Therefore, effluent BOD during the winter months wouldn't be expected to be above 160 mg/L (Refer to performance Evaluation of Primary Sewage Lagoon in Iqaluit, N.W.T. by Ken Johnson and John Cucheran). A BOD effluent at that level, will provide a BOD removal of approximately 30% based on a BOD influent of 232 mg/L as measured from the testing developed during the summer months, which is much better than the current BOD removal obtained by the WWTP of 9%.

SUMMARY

Based on the recent test diversion to the lagoon and the current performance of the wastewater treatment plant, it is anticipated that the lagoon will provide a much higher level of treatment both at the beginning and end of the diversion.

Please note again that the wastewater treatment plant cannot be upgraded without the interrupting flow to the plant for the 4-month period. The headworks is receiving a complete upgrade with increased robustness, capacity, and redundancy. In

addition, the Contractor Kudlik Construction, anticipates that a shutdown of nearer to 2-months will be required, however, we have based our analysis on a 4 months period in the event that a longer contingency period is required.

We recommend that the diversion proceed and trust this meets your current requirements.

Should you have any questions, please contact the undersigned.

Sincerely,

Nunami Stantec



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Attachment: Lagoon test summary results

cc. Eslam Maher, Colliers

DRAFT