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**Staff Report**

<b>Applicant:</b> City of Yellowknife	
<b>Location:</b> Yellowknife, NT	<b>File Number:</b> MV2009L3-0007
<b>Date Prepared:</b> February 25, 2019	<b>Date of Board Meeting:</b> March 7, 2019
<b>Subject:</b> Fiddler's Lake Treatment System Plan Version 2	

**1. Purpose**

The purpose of this Report is to present to the Mackenzie Valley Land and Water Board (MVLWB/the Board) the Fiddler's Lake Treatment System Plan Version 2 (FLTSP V2) submitted by the City of Yellowknife (City) in accordance with direction provided in the Board's November 19, 2015 letter to the City, and to fulfill Part D, condition 15 and Schedule 2, condition 3 of municipal Water Licence MV2009L3-0007 (Licence).

**2. Background**

- May 31, 2010 – Issuance of Licence MV2009L3-0007;
- June 28, 2018 – Fiddler's Lake Treatment System Plan Version 2 received;
- July 3, 2018 – Review commenced;
- July 19, 2018 – Review comment and response deadlines extended by Board staff;
- September 7, 2018 – Reviewer comments and recommendations due and received;
- September 25, 2018 – Response deadline extended from September 28, 2018 to October 12, 2018;
- October 5, 2018 – Responses received;
- October 12, 2018 – Responses due;
- December 11, 2018 – Meeting of Parties to discuss review;
- **March 7, 2019 – Fiddler's Lake Treatment System Plan Version 2 presented to the Board;** and
- May 30, 2022 – Expiration of Licence MV2009L3-0007.

**3. Discussion**

Fiddler's Lake Treatment System Plan History

The Fiddler's Lake Treatment System (FLTS or system) is comprised of a natural lake which has been engineered to decant annually and treat wastewater passively through a series of wetlands and small lakes, before final discharge to Great Slave Lake. It has been operated as the City's wastewater treatment system for over 30 years.

The first version of the City's FLTSP was submitted September 23, 2014 (attached), and subsequently distributed for public review. The main findings of the FLTSP were as follows:

- Fiddler's Lake Treatment System meets the effluent quality criteria (EQC) set in Part D, item 2 of the Licence and is projected to continue to be in compliance for the duration of the Licence term.
- The ammonia concentration will be below the effluent discharge objectives (EDO) as set in Schedule 2, item 3b of the Licence. Ammonia concentration at compliance point F3 may exceed the Canadian Council of Ministers of the Environment (CCME) threshold for acute toxicity of ammonia-nitrogen if discharge occurs after spring break-up without some time for treatment. Ammonia concentrations will likely exceed the threshold EDO acute concentration during fall.
- Total Phosphorus (TP) concentration exceeds EDOs and is anticipated to remain greater than the water licence EDO maximum concentration for the Licence term. A supplemental strategy should be considered to reduce total phosphorus concentrations.
- Supplemental strategies for the reduction of TP in the system and ammonia load on the wetland (as a function of earlier decant) may be required to comply with future water licencing requirements.

Following the review, on August 13, 2015 (attached) the Board did not approve the FLTSP and directed Board staff to organize a meeting of interested parties to discuss nutrient monitoring and management for the Fiddler's Lake Treatment System and outflow to Great Slave Lake. The Board stated that the outcomes of this meeting would be used to determine whether further information is required prior to making a decision on the FLTSP.

The meeting of interested parties was held on October 27, 2015. At the meeting there was general agreement that the FLTSP, as it was submitted, does not satisfy all the requirements in the Licence. Meeting participants worked together to develop a recommendation for the Board's consideration (meeting summary notes attached). On November 19, 2015, the outcomes of the meeting of interested parties were presented to the Board (Staff Report attached). The Board did not approve the FLTSP (letter attached), and required the City to submit an update to the FLTSP by March 31, 2016, to include:

- Commitment to do a risk assessment of ammonia and phosphorus concentrations from the Fiddler's Lake Treatment System on Great Slave Lake; this would include a study of the effects that the Fiddler's Lake Treatment System has on eutrophication of the receiving water body, action levels and response plans for ammonia and phosphorus, and a timeline for implementation;
- Analysis of treatment improvement options presented in the Plan including the feasibility of each option; and
- Establishment of triggers and thresholds (providing actual numbers, including, but not limited to: treatment system performance criteria, timelines, or system loadings) for when an upgrade to the Fiddler's Lake Treatment System is required.

On June 29, 2016, the City requested an extension to the submission deadline for the FLTSP Version 2 to May 31, 2018 (along with several other submissions, attached), which the Board granted on September 8, 2016 (attached). The City submitted the FLTSP Version 2 on June 28, 2018.

#### Description of FLTSP Version 2

The City submitted the FLTSP V2 to fulfill Part D, condition 15 and Schedule 2, condition 3 of their municipal Water Licence MV2009L3-0007, and with direction provided in the Board's November 19, 2015 letter to the City (attached). With this submission, the City outlined the results of a Great Slave Lake (GSL) Nutrient Risk Assessment that was conducted in 2017, and concluded that:

- the Fiddler’s Lake Treatment System is not having a eutrophication effect on GSL outside of the Initial Dilution Zone (IDZ);
- ammonia appears to be readily removed on the watershed prior to reaching GSL, so is not an element of concern and therefore no action level or response plan is provided; and
- phosphorus continues to be an element of concern, with nearly half of samples taken in 2017 exceeding the recommended maximum grab sample concentration.

The City also provided an analysis of treatment options, in which the removal of phosphorus by precipitation through batch chemical treatment of wastewater was recommended to improve the phosphorus removal efficiency of the lagoon. The City stated that the costs for removing phosphorus from the lagoon limits its feasibility.

Lastly, the City stated that they are unable to provide actual numbers for treatment system performance criteria, timelines or loadings for when an upgrade to the FLTS is required. The City is moving forward with a sludge removal program, and believes that following the quantification of sludge volumes, the sludge removal and disposal process, they anticipate an increase in phosphorus removal efficiency in the lagoon. The City plans to reevaluate treatment options following the collection of data to demonstrate any effect of desludging on phosphorus removal, with the goal of meeting the discharge objective for phosphorus in the Licence.

#### Licence Requirements

The FLTSP is required to fulfill Part D, condition 15 and Schedule 2, condition 3 of Licence MV2009L3-0007 (see Appendix A), as well as Board direction provided in the November 19, 2015 letter to the City (attached).

Part D, condition 15 was included in the Licence as per recommendations from Environment Canada and Indigenous and Northern Affairs Canada, during their interventions for the City’s Licence Application process in 2009 (see pg. 14 of 17 in Reasons for Decision, attached).

#### **4. Comments**

On November 30, 2018, the City submitted a revised Sewage Disposal Facilities Operation and Maintenance Plan (Version 2, attached). On December 19, 2018 (attached), Board staff wrote to the City to request resubmission of this plan, as it did not include the revisions required in the Board’s August 17, 2017 letter denying approval of the Plan, Version 1 (attached), including submission of a complete sludge management plan, in accordance with Schedule 4, condition 1 (e) of the Licence. To date, the City has not indicated when they will be able to submit a revised Sewage Disposal Facilities Operation and Maintenance Plan (Version 2) that includes a sludge management plan to fulfill Licence requirements. However, the City has demonstrated that they are actively working toward developing a sludge management plan for the Fiddler’s Lake lagoon (see section 5, below).

#### **5. Public Review**

By September 7, 2018, comments and recommendations on the FLTSP V2 were received from Environment and Climate Change Canada (ECCC), the Government of the Northwest Territories Department of Environment and Natural Resources (GNWT-ENR), and Board staff.

The City responded by October 12, 2018, following an extension to the response deadline by Board staff from September 28, 2018. The Review Summary and Attachments (attached) presents the concerns identified through this review.

Board staff contracted Golder Associates Ltd. to assist with the technical review of the FLTSP V2 and with the analysis of reviewer comments and the City's responses. Board staff note that the Review Comment Table generated as a result of the review of the FLTSP V2 contains a high level of technical detail, so have included a high-level summary of the issues raised, as follows:

#### Main Issues Raised during the Review

The following summarizes the main issues raised during the review:

- Sludge management at the Fiddler's Lake lagoon and its effect on treatment efficacy and phosphorus removal from the system;
- Design of, and conclusions reached through, the Nutrient Risk Assessment for phosphorus undertaken by the City in 2017;
- The need for additional monitoring and investigation of treatment options to reduce phosphorus loadings to the FLTS; and
- Provision of a timeline for, and details around, establishing the triggers and thresholds, related to phosphorus, requested by the Board.

Following the review, Board staff identified the need to organize a meeting of parties to discuss a number of issues that were raised with respect to the submission itself, as well as next steps in the process. The distribution list was notified of this meeting on November 16, 2018 (attached), and the meeting of parties was held December 11, 2018 (summary notes attached).

In summary, there remains work to be done to delineate the potential impacts of phosphorus from the FLTS on Great Slave Lake; reviewers agreed at the meeting of parties that the best way to address these outstanding questions is to work collaboratively to leverage ongoing academic research on the FLTS, as opposed to continuing to require the City to hire consultants to conduct discrete studies. Information about ongoing research was shared, and the parties agreed to hold a follow-up meeting in October 2019 to again coordinate on ongoing and potential research projects in collaboration with academics. Board staff have and will continue to maintain an open dialogue with City staff and reviewers regarding ongoing research and its relevance to the FLTS. Parties also discussed that the Wastewater System Effluent Regulations were enacted under the *Fisheries Act* and apply to municipal wastewater effluents in the provinces, but do not yet apply to the territories. After a few years of inactivity, ECCO is again working on establishing Northern Performance Standards for northern municipal wastewater effluents; this work may also contribute guidance that regulators could recommend in future for the Fiddler's Lake system.

In addition, the City shared its plans for desludging the Fiddler's Lake lagoon during the December 11, 2018 meeting. This is currently the only update to the system that the City is planning, and due to the natural variation in the lagoon bed, its size, and the fact that it has not been previously desludged, the City estimates the process will take from 2020-2022. It was agreed by all at the meeting of parties that desludging the lagoon could have a positive impact on treatment efficacy and phosphorus removal from the system, and that the City's resources would be best spent on this activity rather than further studies, since research on the system is being conducted by academics and federal government departments, who are better equipped to conduct these types of research.

Board staff and reviewers will continue to monitor SNP results from the Fiddler's Lake system through the City's submission of quarterly SNP reporting as well as annual water licence reporting (as required by Part E, condition 1 of the SNP and Part B, condition 3 and Schedule 1, condition 1 of the Licence), as well as continue to coordinate our collective understanding of ongoing and proposed research programs and results.

## **6. Security**

Not applicable.

## **7. Conclusion**

Board staff conclude that further information was provided by the City in their responses to reviewer comments, and that reviewers, Board staff and the City reached important conclusions at the December 11, 2018 meeting of parties. Board staff conclude that the FLTSP V2, as submitted, is not in conformity with the requirements of Licence MV2009L3-0007. However, Board staff conclude that requiring the City to continue to attempt to address the requirements of the Licence with respect to assessing the potential impacts of the FLTS on Great Slave Lake will be far less effective than working collaboratively to address outstanding questions through ongoing and potential academic research. In addition, Board staff conclude that continuing to monitor the City's analytical results in their quarterly SNP reporting and annual reporting, now and through the process of desludging Fiddler's Lake lagoon (which includes the submission of a sludge management plan, as part of the revised Sewage Disposal Facilities Operation and Maintenance Plan), will add to the collective understanding of the system's treatment efficacy.

## **8. Recommendation**

Board staff recommend the Board acknowledge the Fiddler's Lake Treatment System Plan Version 2, as submitted by the City. Board staff also recommend that the Board acknowledge the outcomes of the December 11, 2018 meeting of parties.

As such, Board staff recommend including the following text in the decision letter (draft attached):

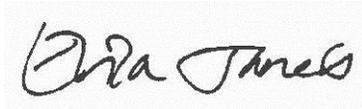
- The Board encourages the City to continue to participate in dialogue with Board staff and reviewers concerning ongoing and proposed research programs and results related to the FLTS, and looks forward to guidance that these may provide in future.
- The Board anticipates the City's submission of a desludging plan for the Fiddler's Lake lagoon as part of the revised Sewage Disposal Facilities Operation and Maintenance Plan (Version 2), and the City's continued diligence in submitting quarterly SNP and annual reporting under their Licence, so that any resulting changes in lagoon treatment efficacy may be monitored.
- The Board notes and appreciates the City's efforts to submit requirements in accordance with Licence MV2009L3-0007.

## **9. Attachments**

- [Fiddler's Lake Treatment System Plan Version 1](#)
- [August 13, 2015 Board letter to City directing meeting of parties on FLTSP](#)
- [Summary notes from October 27, 2015 Meeting of Parties on City FLTSP](#)
- [November 19, 2015 Staff Report: FLTSP Meeting outcomes](#)
- [November 19, 2015 Board letter denying approval of FLTSP V1](#)
- [Fiddler's Lake Treatment System Plan Version 2](#)
- [June 29, 2016 City letter requesting extension to submission deadlines](#)

- [September 8, 2016 Board letter granting extension to Updated FLTSP submission deadline](#)
- [June 2, 2010 Board issuance letter, including Reasons for Decision](#)
- [Sewage Disposal Facilities Operation and Maintenance Plan, Version 2](#)
- [December 19, 2018 Board staff letter requesting resubmission of Sewage Disposal Facilities Operation and Maintenance Plan, Version 2](#)
- [August 17, 2017 Board letter denying Sewage Disposal Facilities Operation and Maintenance Plan Version 1](#)
- [November 16, 2018 Meeting of Parties notification to distribution list](#)
- [December 11, 2018 Summary Notes from Meeting of Parties](#)
- Review Summary and Attachments
- Draft Letter from the Board

Respectfully submitted,



Erica Janes  
Regulatory Specialist



Heather Scott  
Senior Technical Advisor

## Appendix A: Licence Conditions

Part D, condition 15 of MV2009L3-0007 states:

The Licensee shall by March 31, 2012, submit to the Board for approval, a revised Fiddlers Lake treatment system plan that shall include, but is not limited to, the information as set in Schedule 2, item 3, included in this Licence.

Schedule 2, condition 3 of MV2009L3-0007 states:

The revised Fiddlers Lake Treatment System Plan shall include, but not be limited to the following:

- a) Discussion on the triggers and thresholds that will be employed to determine when an upgrade to the Fiddler's Lake treatment system is required, which shall include, but not be limited to: consideration to influent loadings (volume and concentration); effluent water quality; effluent loadings to receiving water bodies; treatment time within the system, and time requirements to complete any studies or design that supports the upgrade;
- b) Discussion of how ammonia and phosphorous treatment will be completed to meet the following discharge objectives: average concentration for ammonia of 5 mg/L (maximum of 10 mg/L), average concentration for phosphorous of 1 mg/L (maximum of 2 mg/L);
- c) Details, analysis of results, and recommendations from any wastewater treatment study, may include, but not limited to, a wetland performance study during cold weather and a lagoon pre-treatment study; and
- d) Details of a phosphorous study into the loadings into receiving water bodies and associated potential impacts.

## Review Comment Table

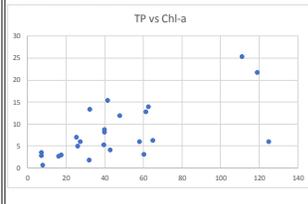
<b>Board:</b>	MVLWB
<b>Review Item:</b>	City of Yellowknife - Fiddlers Lake Treatment System Plan Version 2 (MV2009L3-0007)
<b>File(s):</b>	<a href="#">MV2009L3-0007</a>
<b>Proponent:</b>	City of Yellowknife
<b>Document(s):</b>	<a href="#">MV2009L3-0007 - City of YK - Fiddlers Lake Treatment System Plan V2 - Jun28-18</a> (12.8 MB) <a href="#">MV2009L3-0007 - City of YK- Fiddlers Lake Treatment System Plan Not Approved - Nov19-15</a> (136.0 KB) <a href="#">MV2009L3-0007 - City of Yk - FLTSP Meeting Oct 27-15 - Meeting notes - Nov12-15</a> (119.0 KB) <a href="#">MV2009L3-0007 - City of YK - Fiddlers Lake System Treatment Plan - Sep23-14</a> (2.7 MB)
<b>Item For Review Distributed On:</b>	July 3 at 10:21 <a href="#">Distribution List</a>
<b>Reviewer Comments Due By:</b>	Sep 7, 2018
<b>Proponent Responses Due By:</b>	Oct 12, 2018
<b>Item Description:</b>	<p><b>September 25, 2018 Update: The City has requested and received an extension to respond to reviewer comments. The new comment response deadline is October 12, 2018.</b></p> <p>-----</p> <p><b>July 19, 2018 Update: Board staff have extended the comment and response deadlines for this review, to allow sufficient time for a thorough review of this submission. The new review comment deadline is September 7, 2018, and the new comment response deadline is September 28, 2018.</b></p> <p>-----</p> <p>The City of Yellowknife has submitted a revised Fiddlers Lake Treatment System Plan (FLSTP, Version 2), in accordance with Part D, condition 15 and Schedule 2, condition 3 of municipal Water Licence MV2009L3-0007, and with direction provided in the Board’s November 19, 2015 letter to the City (see link). This Plan is for Board approval.</p>

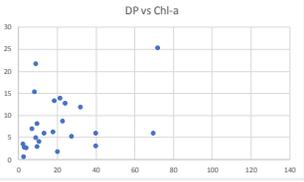
	<p>A meeting was held on October 27, 2015 for interested parties to discuss nutrient monitoring and management for the Fiddlers Lake Treatment System and outflow to Great Slave Lake (see link for meeting summary notes). In light of the City’s submission and the recommendations that arose from this meeting, the Board required a revised FLSTP (Version 2) to be submitted by March 31, 2016. On September 8, 2016, the Board approved the City’s request to extend this deadline to May 31, 2018.</p> <p>Reviewers are encouraged to consult the Board’s November 19, 2015 letter for details on the Board’s required revisions to the FLTSP Version 1. Please submit questions, comments and recommendations on the FLSTP Version 2 by <b>July 26, 2018</b> using the ORS.</p> <p>If you have questions or comments regarding this review or the Online Review System, please contact Erica Janes at (867)766-7466 or <a href="mailto:ejanes@mvlwb.com">ejanes@mvlwb.com</a>.</p>
<p><b>General Reviewer Information:</b></p>	<p>In addition to the email distribution list, the following organization received review materials by fax:</p> <ul style="list-style-type: none"> <li>• NWT Metis Nation: Tim Heron, NWTMN IMA Coordinator: (867)872-3586.</li> </ul>
<p><b>Contact Information:</b></p>	<p>Erica Janes 867-766-7466  Heather Scott 867-766-7463  Jen Potten 867-766-7468</p>

## Comment Summary

Environment and Climate Change Canada: Bradley Summerfield				
ID	Topic	Reviewer Comment/Recommendation	Proponent Response	Board Staff Analysis
1	General File	<b>Comment</b> ( <a href="#">doc</a> ) ECCC cover letter <b>Recommendation</b>	--	Noted.
2	June 20, 2018 Letter to MVLWB from City of Yellowknife re: Fiddlers Lake Treatment System Plan	<b>Comment</b> The City of Yellowknife is unable to provide actual numbers for treatment system performance criteria, timelines or loadings for when an upgrade to the Fiddler's Lake Treatment System is required. Phosphorus concentrations peaked at 0032-F1 on March 16th, 2017 with a value of 12.7 mg/L and 45% of 2017 samples were above the objectives from Water Licence Schedule 2 Section 3.b) of 2 mg/L. The City of Yellowknife is moving forward with sludge removal. Sludge removal is anticipated to increase the phosphorus removal efficiency in the lagoon. Once data has been received demonstrating the effect desludging has on phosphorus removal, the options will be reevaluated in order to meet the average concentration for phosphorous of 1 mg/L (maximum of 2 mg/L). <b>Recommendation</b> ECCC supports the sludge removal efforts and tracking the effect of	--	Board staff note that the City received Board approval for extension requests on September 20, 2018 for the submission of the revised Sewage Disposal Facilities and Solid Waste Disposal Facilities Operation and Maintenance Plans, until November 30, 2018. The City indicated in their July 27, 2018 extension request that they are developing a Sludge Management Plan, and that the desludging process may be a multi-year process.  Board staff further note that sludge management and the tracking of the effects of desludging on phosphorus removal may be discussed during the renewal of the City's Licence.  Board staff note that following this review, a meeting of parties was held on December 11, 2018 to discuss review comments and next steps. Parties agreed that in the short term, the City should focus their resources on desludging Fiddler's lagoon, and continued monitoring under their Licence. Parties noted that ongoing and potential research by academics and federal departments will help parties to better understand treatment

		desludging on phosphorus removal.		efficacy of the Fiddler's Lake Treatment System.
3	Great Slave Lake Nutrient Risk Assessment report (Associated Environmental, 2017) Section 3.2.1	<p><b>Comment</b> Sampling was done over four dates from June to Sept 2017. and used a simple gradient design with seven sites located as follows: Site 1 = mouth of discharge channel Site 2 = NF site (edge of IDZ; approx 100m from dischg point) Site 3 = NF site (in bay; approx 300m from dischg point) Site 4 = FF site (approx 600m from dischg point) Site 5 = FF site (approx 800m from dischg point) Site 6 = reference site (&lt;2m deep) 3 km northwest Site 7 = reference site (deep-water site) distant from Site 1 The trophic status was evaluated for the various sites, and the report concluded that Sites 4, 5, and 6 were representative of reference or background conditions. These sites all had total phosphorus concentrations in the meso-eutrophic to eutrophic range; this is not typical of the oligotrophic status of unimpacted areas of Great Slave Lake. Site 6 is 3 km from the outflow, but there is no confirmatory sampling of more distant similar shallow sites that would be clearly not affected by long-term nutrient loadings. Site 7 was in the oligotrophic category based on total phosphorus, and would be</p>	<p><b>Oct 5:</b> As noted in page 20 of the report "Given the shallow nature of the lake in these locations, the bottom sediments are easily disturbed by wind- induced water circulation. This would cause high total phosphorus concentrations in the water column". Dissolved phosphorus is a more sensitive indicator of change in the lake because forms of phosphorus attached to particles are not bioavailable. Chlorophyll A is also a better indicator because it shows the result of increased nutrients increasing algal productivity Sites 4 and 5, which are 600m and 800m from the inflow, are representative of the reference site (having similar results), but are themselves not references sites. The true reference site would be site 6, approximately 3km away from the receiving area, but which still has a similar environment as sites 1-5 (shallow bay). Site 7 would be representative of a deep water location.</p>	<p>Board Staff agree that Sites 4, 5 and 6 should not be considered background or reference. Phosphorus concentrations indicate influence of nutrient loadings at those locations. Site 7 could be considered reference, or preferably, the City could establish a more appropriate near-shore shallow reference station in GSL, located farther than Site 6, where currently there's uncertainty regarding potential effects.</p> <p>In order to determine the form of phosphorus that should be used to develop action levels, recommend collecting more data with a revised study design. A radial gradient design would be more appropriate (described in later in this table). Based on the 2018 data, there appears to be a better relationship between total phosphorus and chlorophyll a than between dissolved phosphorus and chlorophyll a. Two or three years of data would help confirm eutrophication indicators, and also provide more information on background/reference conditions in GSL.</p> <p>See plots of TP vs Chl-a and DP vs Chl-a; TP is the better predictor of Chl-a; however, it may reflect inputs of P from TSS mixed up from bottom sediments.</p>



		<p>the only site sampled that could be considered "background". The report recommends basing management actions on the dissolved forms of phosphorus; ECCC does not agree with this approach. Phosphorus cycles seasonally and within seasons as algal populations cycle, and dissolved phosphorus varies widely, while the total phosphorus is a much better indicator of the available phosphorus in the system. (See CCME 2004, Wetzel 2001).</p> <p><b>Recommendation</b> ECCC recommends that management actions for the Fiddler's System be based on management of total phosphorus, rather than dissolved phosphorus and chlorophyll a, which cycle widely through the seasons. ECCC recommends that areas of the lake in the vicinity of the discharge not be designated as background or reference, unless the water quality and nutrient concentrations are consistent with areas of the lake which are clearly located away from anthropogenic influences.</p>		 <p>Setting action levels using dissolved phosphorus and chlorophyll a is reasonable in the interim for the reasons listed (relationship between TP and TSS, bioavailability). Support developing action levels that basically maintain the area beyond the mixing zone (Sites 4, 5 and 6) in the mesotrophic range (10-20 ug/L, CCME 2004) based on DP.</p> <p>The action levels outlined on page 20 and 21 should be revisited.</p> <p>See Comment ID ECCC 2, above, regarding meeting of parties.</p>
4	<p>Section 3.2.2 (Recommended Water Quality Action Levels) Great Slave Lake Nutrient Risk Assessment report (Associated</p>	<p><b>Comment</b> Section 3.2.2 (Recommended Water Quality Action Levels) The proposed action levels are based on the assumption that a mesotrophic classification represents the average natural condition for the receiving</p>	<p><b>Oct 5:</b> See the above response regarding total phosphorus. On page 20 of the report, an explanation is given for a mesotrophic classification, based on algal</p>	<p>Although it is possible that part of the TP in near-shore water samples originates from resuspended sediments, data are only available for a single station away from the direct influence of the inflow from the FLTS (Site 6), which may not be a suitable reference location.</p>

<p>Environmental, 2017)</p>	<p>environment of the lake at this location (as opposed to the deeper, main basin of Great Slave Lake, which is oligotrophic). Per the report, the proposed action levels (objectives) for dissolved phosphorus and chlorophyll a (collected 30 cm below surface approximately 300 m out from the inflow to the lake) beyond the outer boundary of the Initial Dilution Zone (IDZ) are: . Dissolved Phosphorus: Average of at least four open water samples should not exceed 0.020 mg/L (20 µg/L) dissolved phosphorus, the upper boundary for mesotrophic status based on total phosphorus. A single measurement should not exceed 0.055 mg/L (55 µg/L), representing a 50% increase of the average concentrations at the reference sites. . Chlorophyll a concentration should not exceed 15 µg/L, which is the upper range of the mesotrophic category according to Wetzel (2001). <b>Recommendation</b> ECCC recommends that action levels be based on total phosphorus, as outlined in the previous comment, and requests that the City of Yellowknife provide their recommendations on what those levels should be. ECCC recommends that further</p>	<p>productivity/chlorophyll A supported by dissolved phosphorus. Due to the shallow nature of the lake at these locations, high total phosphorus levels are not because of the inflow nor do they influence algal productivity, but due to wind-suspended particulates.</p>	<p>Additional near-shore sampling for forms of P and chlorophyll a outside the potentially affected area would be required to verify use of DP as the key variable for the Action Levels, and to confirm background nutrient concentrations in nearshore areas of GSL. Given the limited information available, and uncertainty regarding source of particulate P, use of DP in combination with chlorophyll a appears reasonable to base Action Levels on, until more monitoring data are available.</p> <p>Could request that the City provide the following plots after two years of data:</p> <ol style="list-style-type: none"> <li>1) TSS vs DP</li> <li>2) TSS vs TP</li> <li>3) DP vs TP</li> <li>4) TP vs Chlor a</li> <li>5) DP vs Chlor a</li> </ol> <p>See Comment ID ECCC 2, above, regarding meeting of parties.</p>
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		justification be provided for the use of a mesotrophic classification as the average natural condition.		
5	Great Slave Lake Nutrient Risk Assessment report (Associated Environmental, 2017) Section 3.3	<p><b>Comment</b> Monitoring has indicated that the effluent discharge objectives for phosphorus are not being met. There are very high phosphorus concentrations at the inflow and at the next nearest site out into the lake (at least 100-200 m out). As described in Section 3.3, there is likely long-term storage of phosphorus in upstream wetland or pond sediments due to the inputs of treated municipal wastewater over many years. The system may be saturated.</p> <p><b>Recommendation</b> Given that the treatment system may be saturated with phosphorus, ECCC recommends that the treatment system plan specify how this would affect the system operation and final effluent quality in the short-term and long-term under current and projected future population levels and wastewater volumes.</p>	<p><b>Oct 5:</b> Any phosphorus saturation in the FLTS would not influence system operation. The City is planning to desludge Fiddler's lagoon, which is anticipated to reduce phosphorus concentrations in the effluent. The GNWT Bureau of Statistics is projecting an increase in population for Yellowknife of 2,500 by 2035. This is a very small increase in population that is not expected to have an impact on the City's wastewater system.</p>	<p>Reassessment of the quality of the inflow to GSL, and associated effects in GSL is recommended following de-sludging of Fiddler's Lagoon. In the meantime, additional data collection on nutrient and chlorophyll a concentrations in near-shore reference areas in GSL, along with more spatially extensive monitoring at the inflow, are recommended to allow greater confidence when setting updated Action Levels, and for evaluating effects in GSL.</p> <p>See Comment ID ECCC 2, above, regarding meeting of parties.</p>
6	Great Slave Lake Nutrient Risk Assessment report (Associated Environmental, 2017)	<p><b>Comment</b> The report states that: "Based on bioavailable forms of phosphorus (dissolved) and chlorophyll a, we found no evidence to suggest that the inflow is causing increased eutrophication beyond</p>	<p><b>Oct 5:</b> There appears to be contradiction in the first item. If data has not been tracked over time, how do we know that the trophic status has changed? Does ECCC have data they can</p>	<p>Agree with ECCC that there could be a greater effect, but lack of information prevents an evaluation. There is uncertainty in the severity and spatial extent of the effect on nutrients and productivity, because of the limited spatial scale of the field study and lack of conclusive</p>

	<p>the receiving area at this time. Only a significant increase in phosphorus delivered to wider areas of the lake would cause a change in the trophic status outside the current receiving area. Any population growth in Yellowknife that results in significant increases in the volume of wastewater produced could result in such higher inputs over time." The Nutrient Risk Assessment Report further states that "Only a significant increase in phosphorus delivered to wider areas of the lake would cause a change in the trophic status outside the current receiving area. Any population growth in Yellowknife that results in significant increases in the volume of wastewater produced could result in such higher inputs over time". The report does not specify what is meant by "significant".</p> <p><b>Recommendation</b> ECCC does not agree with the statement that there is no increased eutrophication beyond the receiving area; this has not been tracked over time, but the trophic status has changed in the discharge area to range from eutrophic to meso-eutrophic. ECCC requests clarification (such as concentration/ loading/ volume) regarding what is meant by "significant increase in phosphorus" and by "significant</p>	<p>provide that shows the change? The City is working to define what a "significant increase" would be for both phosphorus and the volume of wastewater. Defining "significant increase" is not a simple task and will take some time to determine. See previous comment on Yellowknife Population.</p>	<p>data on near-shore background water quality and chlorophyll a.</p> <p>Other jurisdictions treat this issue similarly to other projects in the NWT. There is general recognition that downstream of a municipal (or other) discharge, an agreed-upon area will be affected. However, municipalities are generally required to project anticipated loadings, routinely monitor effluent and downstream of their operations (to determine spatial extent of effect), adhere to discharge limits, track concentrations in receiving environment over time, etc.</p> <p>Continuous monitoring and reporting, with the assessment including temporal and spatial analyses is recommended.</p> <p>See Comment ID ECCC 2, above, regarding meeting of parties.</p>
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		<p>increases in the volume of wastewater produced" ECCC further recommends incorporating projected population growth and wastewater estimates into the Fiddlers Lake Treatment System plan, with periodic updates to these projections.</p>		
7	<p>Great Slave Lake Nutrient Risk Assessment report (Associated Environmental, 2017)</p>	<p><b>Comment</b> Conclusions &amp; recommendations (Section 4): The 2017 monitoring program has provided the first recent characterization of water quality in the receiving area of Great Slave Lake. To confirm the findings from 2017 and assess year-to-year variation, the authors of the report recommend monitoring the receiving area of the lake during the open water seasons in 2018 and 2019. Effects associated with the nutrient loading may be more evident during ice-cover conditons. To characterize the conditions in winter, when decomposition of the algae reduces oxygen levels, and when phosphorus is released from the sediments, under-ice monitoring should be done. The report concludes that phosphorus may require further treatment prior to release from the lagoon, should nutrients become a future requirement for water licence compliance. <b>Recommendation</b> ECCC supports the proposed continued water quality</p>	<p><b>Oct 5:</b> The City will be continuing water quality monitoring of the receiving area of Great Slave Lake in 2019 and onward. The City will not be adding under-ice monitoring at this time, but will consider the addition in the future. Furthermore, the City is not discharging from the lagoon when there is Ice Cover on Great Slave Lake. The City will wait to see the effect of de-sludging activities before further investigation of treatment options for phosphorus.</p>	<p>Acceptable response. Recommend continuing to collect open-water data as the priority. However, changes to the open-water study design are recommended.</p> <p>See Comment ID ECCC 2, above, regarding meeting of parties.</p>

		<p>monitoring of the receiving area of Great Slave Lake during 2018 and 2019. ECCC recommends adding under-ice monitoring in the lake areas just outside the 2m depth in the area of the discharge, to identify dissolved oxygen conditions and water quality. ECCC notes that nutrient enrichment extends over 800 m into Great Slave Lake, and represents an extensive zone of alteration. To reduce the impacted area, ECCC supports the investigation of treatment options that could reduce the phosphorus loadings from the Fiddlers system.</p>		
8	<p>Phosphorus removal system Treatment Improvements Options Analysis report (Associated Environmental, 2017) 3.3 TREATMENT EFFICACY</p>	<p><b>Comment</b> The report states "It may be difficult to achieve such low total P levels (i.e. 1.0 mg P/L total phosphorus average) for the decanted effluent at all times. However, since the actual compliance point is not at the lagoon decant structure but downstream of the wetland system, and assuming the wetland does provide further some P removal, as suggested in the FLTSP, it is reasonable to expect that the water license objective can be attained, or nearly so, at the compliance point." <b>Recommendation</b> ECCC recommends review of the compliance point for total phosphorus, in light of the potential issue of saturation of the system</p>	<p><b>Oct 5:</b> The compliance point is set by the MVLWB. During the City's next water licence application, the location of the compliance point can be discussed.</p>	<p>There appears to be no reason to change the compliance point at this time. It can be reviewed once de-sludging is completed and/or in next water licence process, along with compliance limits.  See Comment ID ECCC 2, above, regarding meeting of parties.</p>

		and the potential for internal loadings.		
<b>GNWT - ENR: Central Email GNWT</b>				
<b>ID</b>	<b>Topic</b>	<b>Reviewer Comment/Recommendation</b>	<b>Proponent Response</b>	<b>Board Staff Analysis</b>
5	General File	<b>Comment</b> ( <a href="#">doc</a> ) ENR Letter with Comments and Recommendations <b>Recommendation</b>	--	Noted.
1	Topic 1: Triggers and Thresholds Not Yet Provided	<b>Comment</b> The current Risk Assessment Report is confirming changes in the Great Slave Lake (GSL) receiving environment by specifying that it would appear that phosphorus in this ecosystem has been accumulating over a long period of time, and that reducing potential effects of phosphorus enrichment downstream of Fiddler's lagoon will take time despite additional treatment. As such, treatment improvements may not reduce the phosphorus influx to Great Slave Lake for several years because of retention and release in the wetland/stream system downstream of the Fiddler's Lake Treatment System (FLTS). The report stated that phosphorus values monitored at SNP 0032-F1 were above guidelines 45% of the time in 2017, and that values as high as 12,7 mg/L were also found in the GSL receiving environment. In response to the first submission of the Fiddler's Lake Treatment System Plan (FLTSP) V1, the MVLWB	<b>Oct 5:</b> The City is moving forward with de-sludging activities which will occur for at least the next three years. We anticipate that post de-sludging, the phosphorus removal efficiency of the lagoon will increase. Once the de-sludging has been completed, the City will assess how desludging has effected phosphorus in the effluent of the FLTS, and reevaluate any options for improving phosphorus removal, if necessary. At that time the City will be in a position to determine triggers and thresholds for the FLTSP.	Acceptable response.  See Comment ID ECCC 2, above, regarding meeting of parties.

		<p>issued a letter to the City of Yellowknife dated November 19th 2015 which outlined specific Water Licence requirements that were then missing from the FLTSP, and should be included in the next version. Amongst details to be provided in V2 were triggers and thresholds, with actual numbers, including but not limited to treatment system performance criteria, timelines and loadings that would indicate when an upgrade to the Fiddler's Lake Treatment System would be required (as per Schedule 2, Item 3(a) of the Water Licence). The City stated in the Fiddler's Lake Treatment System Plan V2 introduction letter, that they were unable at this time to provide the information on triggers and thresholds, as first requested in March 2012 (2009 Water Licence requirements), and again in the November 19, 2015 MVLWB letter. The City mentioned sludge removal plans to occur over several years, although no associated timeline were otherwise provided. Overall, triggers, associated responses and timelines to address/prevent eutrophication effects on the receiving environment through operations and maintenance actions such as sludge removal,</p>		
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		<p>improvements/upgrades to the system towards promoting long term health/efficiency of the FLTS and GSL receiving environment have not yet been provided. ENR is concerned that establishment of triggers and thresholds to identify the need for upgrades to maintain the treatment capabilities and overall health of the Fiddler's drainage system (consequently extending its operating life) and its GSL receiving environment - were missing again from the latest version of the City's FLTSP.</p> <p><b>Recommendation</b> 1) ENR recommends that the City provide a timeline for establishing the triggers and thresholds requested by the Board.</p>		
2	<p>Topic 2: Phosphorus Saturation in the Receiving Environment</p>	<p><b>Comment</b> Section 3.3 of the report specifies that data from the City indicated that phosphorus levels from SNP 0032-F1 were similar to those measured in Site 1 of the GSL receiving environment, meaning that there was little attenuation of phosphorus for the last few kilometers of the stream. Furthermore, phosphorus levels were also elevated in Site 1 in June prior to release of wastewater effluent flow from the Fiddler's drainage system, indicating a systemic ongoing phosphorus</p>	<p><b>Oct 5:</b> The City is moving forward with de-sludging activities for at least the next three years. Until this has been completed, triggers and thresholds for phosphorus will not be established.</p>	<p>The Board's Consultant, Golder and Associates, recommended:</p> <p>"We support setting action levels in the receiving environment (GSL), pending a monitoring program in place to detect change.</p> <p>A proposed approach would be to set interim action levels to maintain conditions (mesotrophic based on DP) within a certain spatial area. Based on the City's population response, they are not expecting the water quality to worsen, nor expand the affected area.</p> <p>Outside of the Response Framework:</p>

	<p>supply to the GSL receiving environment, likely from long term storage of phosphorus due to inputs of municipal wastewater (as well as natural sources) over many years. The Associated Environmental Great Slave Lake Nutrient Risk Assessment report concludes by stating that evidence of eutrophication beyond the local area was not detected based on measured levels of bioavailable forms of phosphorus (dissolved) and chlorophyll a, and that GSL as a whole would not be susceptible to eutrophication from FLTS considering its large area and volume. Section 3.4 however, also concluded by stating that "Only a significant increase in phosphorus delivered to wider areas of the lake would cause a change in the trophic status outside the current receiving area. Any population growth in Yellowknife that results in significant increases in the volume of wastewater produced could result in such higher inputs over time." ENR notes that the Fiddler's Lakes Drainage System has been consistently contributing over ~8,100,000 L/day (or 8,100 m3/day) to Great Slave Lake since the early 90s (and earlier), and that the FLTSP (V1) projected increases to ~ 10,250 m3/day for 2031 were</p>		<ul style="list-style-type: none"> <li>• Water quality in the FLTS system should be reported and plotted annually, with a temporal perspective (backward-looking). Plots should be routinely reviewed for increases.</li> <li>• Revised EQC could include a loading limit for nutrients, estimated based on assimilative capacity of the receiving waterbody."</li> </ul> <p>See Comment ID ECCC 2, above, regarding meeting of parties.</p>
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		<p>already surpassed from 2011 (11,795 m<sup>3</sup>/day) to 2014 inclusively (13,340 m<sup>3</sup>/day), as per information submitted in Annual Reports. A 2017 report produced by the Canadian Water Network on Nutrient Management -Research Insights for Decision Makers specifies on p. 21 of 26 that there has been numerous knowledge advancements in the area of nutrient management over the last 10 or 15 years. Amongst key insights from the collective research identified as particularly relevant for developing effective nutrient-management policies and practices are that "Nutrient legacies may be critical to how the systems respond to management actions", and "Timeframes between management actions and ecosystem responses can be very long." The November 2015 Board letter to the City requested details on "action levels and response plans for ammonia and phosphorus, and a timeline for implementation." Action levels were provided for a point located 300 m away from the inflow point into GSL. ENR is of the opinion that action levels and response plans should also be provided with concentrations within the FLTS, such as levels</p>		
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		<p>measured at SNP-0032-F1 and/or SNP-0032-F3, that would trigger the need for actions, such as de-sludging of the Fiddler's lagoon.</p> <p><b>Recommendation</b> 1) ENR recommends that the City provide details on action levels and response plans for phosphorus, to be established at a sampling point located within the FLTS before reaching the receiving environment of GSL, such as SNP 0032-F1 and/or SNP 0032-F3. In addition, ENR recommends that the City provide a timeline for implementation.</p>		
3	<p>Topic 3: Treatment &amp; Upgrades Options - Feasibility and Costs</p>	<p><b>Comment</b> Two options were suggested for phosphorus treatment, identified as 1) Phosphorus removal and 2) Nitrification. While chemical phosphorus removal would improve the phosphorus removal efficiency of the lagoon via chemical precipitation, it would also notably increase TSS concentrations which would in turn increase the rate of sludge accumulation and require electrical power and the erection of a new road. Nitrification was not further investigated as ammonia was deemed to not be an element of concern. An Engineering analysis produced by Reid Crowther &amp; Partners on Performance and Improvement Strategies for the City's Wastewater</p>	--	<p>Noted.</p> <p>See Comment ID ECCC 2, above, regarding meeting of parties.</p>

		<p>Treatment System (1990) was prepared in 1990 due to compliance issues of achieving treatment objectives EQCs at SNP 0032-F6 (e.g. see DIAND inspectors letter, July 1992). The compliance point initially located at SNP 0032-F6 (lagoon outlet - decant controlled discharge) was subsequently moved half way downstream in the FLTS to SNP 0032-F3 where no control on wastewater discharge is possible. This report also concluded constructing a second lagoon in the area of SNP 0032-F5 would increase the retention period from ~ 7-8 months to over 1 year, therefore optimizing wastewater treatment prior to being released into the wetland/drainage area.</p> <p><b>Recommendation 1)</b> ENR recommends that the City act proactively and take the relevant steps and actions towards maintaining the health and treatment capabilities of their natural FLTS, to avoid further impacts to the receiving environment and within the FLTS itself.</p>		
4	None	<p><b>Comment</b> None</p> <p><b>Recommendation 2)</b> ENR recommends for a timeline surrounding planned de-sludging actions of Fiddlers lagoon to be clearly outlined.</p>	<p><b>Oct 5:</b> The City completed an in depth sludge survey of the lagoon in 2018. The City is working towards establishing a timeline for de-sludging activities and will update the MVLWB when it has</p>	<p>Noted.</p> <p>See Comment ID ECCC 2, above, regarding meeting of parties.</p>

			been determined. It is anticipated de-sludging will occur for at least the next three years.	
MVLWB: Erica Janes				
ID	Topic	Reviewer Comment/Recommendation	Proponent Response	Board Staff Analysis
1	Great Slave Lake Nutrient Risk Assessment: Treatment Improvement Options Analysis Report	<b>Comment</b> The Board's letter to the City, dated November 19, 2015, stated that "the Board requires the following information to be submitted by March 31, 2016: (1) Commitment to do a risk assessment of ammonia and phosphorus concentrations from the Fiddler's Lake Treatment System on Great Slave Lake; this would include a study of the effects that the Fiddler's Lake Treatment System has on eutrophication of the receiving water body, action levels and response plans for ammonia and phosphorus, and a timeline for implementation; (2) Analysis of treatment improvement options presented in the FLTSP including the feasibility of each option; and (3) Establishment of triggers and thresholds (providing actual numbers, including but limited to: treatment system performance criteria, timelines, or loadings) for when an upgrade to the Fiddler's Lake Treatment System is required." In the cover letter it states that "only	<b>Oct 5:</b> The report, "Great Slave Lake Nutrient Risk Assessment Treatment Improvement Options Analysis" contains sensitive information. For this reason, only portions of the report were released as part of the updated FLTSP.	Noted.  See Comment ID ECCC 2, above, regarding meeting of parties.

		<p>those sections of the report that address the items requested by the MVLWB are included with this letter". As the entire report was not provided by the City it is unclear as to if any other analysis of treatment improvement options presented in the FLTSP, including feasibility of each option, was conducted.</p> <p><b>Recommendation</b> Can the City provide the "Great Slave Lake Nutrient Risk Assessment: Treatment Improvement Options Analysis", as per the Board's requirements?</p>		
2	Sampling Design: Transect	<p><b>Comment</b> Google images taken on August 22, 2017 (one day prior to the City's sampling event) indicates that the plume from the Fiddler's system in hugging the west shore and that winds are likely southeast, based on wave patterns. The Sampling Design image illustrates that the transect sampled extended directly into Great Slave Lake; however, the small bays along the shoreline may be where the plume effects are recognized.</p> <p><b>Recommendation</b> Can the City please provide rationale for sampling the transect into Great Slave Lake, when it appears to not align with the plume from the Fiddler's system?</p>	<p><b>Oct 5:</b> There was no visible plume based on turbidity measurements in the field. It would not be practical to change the design of the study to follow changing wind patterns. The objective of the nutrient risk assessment was to determine whether the current and projected future loading of nutrients to Great Slave Lake (GSL) from FLTS pose a risk of causing eutrophication in the immediate receiving area of the lake. Although a single transect could potentially identify a plume (if it exists), it was not the objective of the study. In order to identify the exact</p>	<p>Golder and Associates, consultant to Board Staff, notes:</p> <p>"The City states that the objective of the nutrient risk assessment was to determine whether the current and projected future loading of nutrients to Great Slave Lake (GSL) from FLTS pose a risk of causing eutrophication in the immediate receiving area of the lake. The existing study design does not adequately characterize the immediate receiving area.</p> <p>We recommend a radial gradient design: this would involve sampling several points (e.g., 3) along a radius at 4 distances out. This would account for the effluent dispersing in different directions. Small additional effort for much greater gain in information (1-2 days of field work). In addition, new reference stations (e.g., one in either direction from the</p>

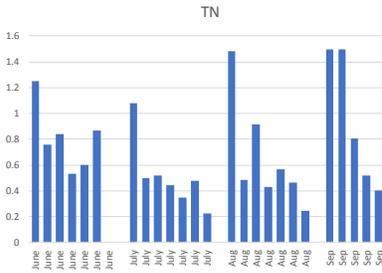
			<p>route of the outflow, multiple transects would be required, and even then given the size of GSL, may not be successful in preciseness. Identification of the route was not an objective of this study. The number and location of sampling sites are consistent with the approach used for receiving environment monitoring of point discharges (including municipal outfalls) in Canada.</p>	<p>outflow) should be established farther from the FLTS outflow location than Site 6. Recommending at least 10 km away.</p> <p>This proposed change would result in 12 stations rather than 7, but the City could sample less frequently (e.g., July, Aug, Sept) in order to maintain approximately the same sampling effort. It is recognized that resources are limited.”</p> <p>Therefore, Board Staff recommend the City change the study design in future monitoring programs to a radial gradient design, to better characterize water quality in the immediate receiving area. Sampling could occur three times per open-water season (July, August and mid/late September), rather than four times, to offset the effort for sampling additional stations.</p> <p>It is also recommended that the City not consider Site 4, 5, or 6 reference; a new shallow reference location should be established.</p> <p>See Comment ID ECCC 2, above, regarding meeting of parties.</p>
3	<p>Sampling Design: Spatial extent of sampling at the mouth of the discharge channel in terms of direction of sampling and spatial coverage</p>	<p><b>Comment</b> Sampling stations were located northwest of the small island located approximately 0.5 km south of the inflow. However, there is another "channel" available for the incoming water to follow, directly to the south.</p>	<p><b>Oct 5:</b> Dillon confirmed that there is only one flow path to Great Slave Lake. An updated report was submitted to the Board May 7, 2018 and was accepted June 9, 2018.</p>	<p>Confirmation of flow path data/drainage data required.</p> <p>See Comment ID ECCC 2, above, regarding meeting of parties.</p>

		<p><b>Recommendation</b> Can the City please provide rationale for sampling along only one of the two possible main flow paths in the receiving area of GSL?</p>		
4	<p>Sampling Design: Spatial extent of sampling in relation to described discharge paths from Lake F3 to Great Slave Lake</p>	<p><b>Comment</b> The Dillon (2014, 2017) reports describe that the Fiddler's Lake Treatment System Plan identified two inflows to GSL from the Fiddler's Lake wastewater lagoon system: the one sampled by Associated Environmental (2017) and another one approximately 5 km to the south (see Figure 1 in Dillon 2014). References: Associated Environmental. 2017. Great Slave Lake Nutrient Risk Assessment. Prepared for the City of Yellowknife, December 2017. Dillon Consulting Limited. 2014. Fiddler's lake Treatment System Plan - Final Report. Prepared for Public Works and Engineering, City of Yellowknife, September 2014. Dillon Consulting Limited. 2017. Fiddler's Lake Treatment System Studies and Management Plan. Prepared for Public Works and Engineering, City of Yellowknife, April 2017.</p> <p><b>Recommendation</b> Can the City please provide rationale for not sampling both inflow locations to GSL from the Fiddler's Lake wastewater lagoon system?</p>	<p><b>Oct 5:</b> See previous comment. Dillon confirmed that there is only one flow path to GSL, which was used for this study.</p>	<p>As above.</p> <p>See Comment ID ECCC 2, above, regarding meeting of parties.</p>

5	Study Questions	<p><b>Comment</b> Study Question D in Section 2.4 refers to the "normal range of variation (background) for Great Slave Lake" in concentrations of parameters of interest. Associated Environmental (2017) indicated that there were no recent water quality studies of GSL to characterize normal ranges and proceeded to consider Sites 4 (600 m from inflow) to 7 (6 km from inflow) as "representative of lake conditions distant from influence from the inflow". Even if these sites were not influenced by the inflow from the Fiddler's Lake lagoon system, the data collected are restricted to a single open-water season and spatially limited. Associated Environmental. 2017. Great Slave Lake Nutrient Risk Assessment. Prepared for the City of Yellowknife, December 2017.</p> <p><b>Recommendation</b> Please provide reasons for why these results are likely representative of normal ranges and whether additional data collection would be useful to arrive at more accurate ranges.</p>	<p><b>Oct 5:</b> The results from this study are indicative of one season and not representative of the longer term. The study recommended additional sampling, which the City intends to continue in 2019.</p>	<p>See Comment ID ECCC 2, above, regarding meeting of parties.</p>
6	Study Questions	<p><b>Comment</b> In 3.1 Sampling Results in 2017 (Page 11) the report states that "Sites 4 through 7 were considered representative of lake conditions distant from influence from the inflow at Site 1". A few more times in the report it</p>	<p><b>Oct 5:</b> Sites 4 and 5, which are 600m and 800m from the inflow, are representative of the reference site (having similar results), but are themselves not</p>	<p>Site 6, which is 3 km away, has water quality similar to Sites 4 and 5 and should, therefore, not be considered a reference location.</p> <p>A new shallow reference site, perhaps to the east of the main inflow, should be established.</p>

		<p>is stated that Sites 4 through 7 are reference sites (e.g. 3.1.3 Phosphorus pg 16) despite Table 2-1 referring to Sites 4 and 5 (600 and 800 m away from the discharge point, respectively) as "Immediate receiving area - far field sites". Data in Table 3-1 suggests that many water quality parameters (Chlorophyll a, Total Dissolved Phosphorus, Orthophosphate-Dissolved, Total Phosphorus, Total Nitrogen, Total Kjeldahl Nitrogen, TSS) are higher at Sites 4-6 compared to Site 7, although more replicates and statistical analysis would be required to further support this. Regardless, the trophic status of Sites 4, 5, and 6 (mesotrophic status) are assumed to represent "the average natural condition for the receiving environment of the lake at this location", despite the oligotrophic status at Site 7 and throughout the main basin of Great Slave Lake (page 11).</p> <p><b>Recommendation</b> Can the City clarify if, and provide rationale as to why Sites 4, 5, and 6 are considered reference or receiving environment?</p>	<p>references sites. The true reference site would be sites 6, approximately 3km away from the receiving area, but which still has a similar environment as sites 1-5 (shallow bay). Site 7 would be representative of a deep water location.</p>	<p>See Comment ID ECCC 2, above, regarding meeting of parties.</p>
7	Study Questions	<p><b>Comment</b> None</p> <p><b>Recommendation</b> Can the City provide rational for, and the implications of, using the mesotrophic status as a basis for the</p>	<p><b>Oct 5:</b> Mesotrophic is more protective than using eutrophic as the status. As noted in page 20 of the report, the results of</p>	<p>This question is similar to ECCC #4. Board Staff note that both reviewers were requesting clarity as to why action levels were set at maintaining mesotrophic status when the</p>

		<p>Recommended Water Quality Action Levels (3.2.2 page 20) in terms of minimizing eutrophication effects on Great Slave Lake?</p>	<p>chlorophyll A and dissolved phosphorus are supportive of the mesotrophic status.</p>	<p>farther station and non-influenced areas of GSL tend to be oligotrophic.</p> <p>Currently available information for P and chlorophyll a suggests mesotrophic status in the near-field receiving environment in GSL, with occasionally higher TP concentrations resulting from the discharge (potentially wind-driven). There is uncertainty regarding the trophic status in true near-shore reference locations. However, if the intent is to not allow conditions to worsen during the period when desludging occurs and additional data are collected, preserving mesotrophic status appears reasonable in the near-term.</p> <p>In the interim, it is recommended to:</p> <ul style="list-style-type: none"> <li>• Accept that the mixing zone to Site 3 will have elevated P concentrations</li> <li>• Maintain Sites 4, 5 and potentially 6 (area beyond Site 3) in mesotrophic range based on DP and chlor a for the interim. Spatial extent of plume should not get larger, nor should concentration in this area increase.</li> <li>• Continue monitoring</li> <li>• Re-visit action levels with more data and report on success of de-sludging</li> </ul> <p>See Comment ID ECCC 2, above, regarding meeting of parties.</p>
8	<p>Study Results :Dissolved Oxygen</p>	<p><b>Comment</b> In the Executive Summary (page ii) it states "Dissolved oxygen levels</p>	<p><b>Oct 5:</b> The City will amend the report to include dissolved</p>	<p>Noted.</p>

		<p>were sufficient to support aquatic life at all lake locations." Further, in 3.1.1 Field Parameters dissolved oxygen levels are discussed on page 14: "Dissolved oxygen levels were high and at or near the saturation point at Sites 2, 3, 4, 5, 6, and 7 during all sampling events...ect. " Figure 3-1 shows dissolved oxygen depth profile values in July, August, and September 2017 for Site 7 only. This is the only place in the report where dissolved oxygen values are presented.</p> <p><b>Recommendation</b> In order to substantiate conclusions regarding dissolved oxygen levels, please include dissolved oxygen data from all sites, if possible.</p>	<p>oxygen depth profiles from all sites.</p>	<p>See Comment ID ECCC 2, above, regarding meeting of parties.</p>
9	<p>Study Results: Nitrogen Parameter Data</p>	<p><b>Comment</b> Ammonia and nitrate concentrations appear to indicate no effect to a small-scale effect in June and July, and effects of varying magnitude in August and September, with no obvious spatial trends. Total nitrogen was not plotted, and indicates a more consistent effect of declining magnitude, reaching likely background concentration at Site 7, also suggesting effects extending to a number of kilometres from the inflow location along the gradient sampled.</p> <p><b>Recommendation</b> Can the City re-evaluate spatial</p>	<p><b>Oct 5:</b> Total nitrogen wasn't plotted, but several other nitrogen variants were, including ammonia and nitrate. Total nitrogen should follow a similar trend as total phosphorus.</p>	<p>Board Staff note that TN shows a more consistent gradient-type effect than TP (sites are ordered 1-7 for each month on the quick plot below). TN is &gt;2 times higher at Site 6 compared to Site 7, also suggesting Site 6 is not background.</p>  <p>See Comment ID ECCC 2, above, regarding meeting of parties.</p>

		extent of effects based on the nitrogen parameter data?		
1 0	Study Results: Phosphorus	<p><b>Comment</b> On p. 20, the report states: "The high total phosphorus levels in samples are not because of the inflow nor do they influence algal productivity, but are probably related to the naturally elevated levels of phosphorus present in the water column because of the wind-suspended particulates." Although this is a possibility, it needs to be investigated in greater detail. The suggested approach to do this is to sample along a reference transect located well away from the one sampled during this study (i.e., outside of potential influence from the wastewater outflow stream), and evaluating relationships between TSS/turbidity and nutrient concentrations.</p> <p><b>Recommendation</b> Would the City consider an additional sampling program to investigate the possibility that high total phosphorus levels are related to naturally elevated levels, as confirming this would provide useful insight to understanding the extent of effects of the effluent inflow to GSL, and could guide the development of the Action Level trigger for phosphorus?</p>	<p><b>Oct 5:</b> While additional sampling would be helpful, the City has limited resources available to do so. At this time, the City intends to sample at sites 1 through 6 starting in 2019 in order to gather additional information about the receiving environment. As site 6 is 3km away from the receiving area, and has similar results to sites 4 and 5, it is expected that this site will give us adequate information to develop the action level trigger for phosphorus.</p>	<p>The existing study design provides only limited data; it does not adequately characterize the affected area in GSL and is unlikely to provide an indication of background water quality.</p> <p>See comments above on an adjusted study design, that wouldn't be much more labour-intensive than the existing study, but would better characterize immediate receiving environment.</p> <p>See Comment ID ECCC 2, above, regarding meeting of parties.</p>

1 1	Nutrient Risk Assessment: Future System Loading	<p><b>Comment</b> On the basis of the 2017 monitoring data collected, the findings of the Nutrient Risk Assessment are reasonable. It appears that even though there is substantial loading from Fiddler's Lake, the effluent appears to disperse within 6 km of entering GSL, at least along the direction of the transect sampled. Greater uncertainty exists regarding the lateral extent of the effects along the shoreline. However, on p. 22 of the Nutrient Risk Assessment, it is unclear what population increase would result in wider change in the trophic status outside of the current area. The corresponding total sewage volume in 2017 (3,026,144 m<sup>3</sup>/yr; City of Yellowknife 2018a) was higher compared to 2016 (2,897,807 m<sup>3</sup>/yr; City of Yellowknife 2017), and total phosphorus concentrations at SNP Station 0032-F3 increased between 2015 and 2017. Issues with the flow meters at Lift Station #5 caused artificially high flow readings between 2012 and 2015 (City of Yellowknife 2018b); therefore, the results from those years have been excluded. Given the increase in loading in the past year, there would be value in the City of Yellowknife providing updated growth estimates, effects to</p>	<p><b>Oct 5:</b> As noted in a previous comment, the population of Yellowknife has not changed significantly in the last 12 years, and is not anticipated to increase enough in the short and long term to significantly affect wastewater volumes and loadings. The increase in volumes in 2017 was atypical and was attributed to significant water and sewer construction (flushing of lines). If further study of the extent of any plume and its effect is requested, the City would not be able to do so without outside funding.</p>	<p>Noted. Action levels are more important to address than loading forecasts at this point.</p> <p>See Comment ID ECCC 2, above, regarding meeting of parties.</p>
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		<p>overall loadings, and an evaluation of the anticipated change in extent of the wastewater plume in Great Slave Lake. References: City of Yellowknife. 2017. Water Licence MV2009L3-0007 - 2016 Annual Report. Submitted to the Mackenzie Valley Land and Water Board. March 2017. City of Yellowknife. 2018a. Water Licence MV2009L3-0007 - 2017 Annual Report. Submitted to the Mackenzie Valley Land and Water Board. March 2018. City of Yellowknife. 2018b. Response to Comments on the 2017 Annual Water Licence Report. Submitted to the Mackenzie Valley Land and Water Board. May 2018.</p> <p><b>Recommendation</b> Can the City provide updated loading forecasts to 2022 (year of water licence term), and provide an evaluation of plume extent into GSL and anticipated effect?</p>		
1 2	Initial Dilution Zone	<p><b>Comment</b> MVLWB et al. (2018) states that "although exceedances of WQOs may be allowed within a defined mixing zone, the water quality within or discharged into it should never be acutely toxic to aquatic life." Therefore, it is assumed that water within the wetland system and downstream of the lagoon, should not be acutely lethal to aquatic life. In line with this</p>	<p><b>Oct 5:</b> The City completes the 2 annual toxicity sampling events at SNP 0032-F3 as required by the water licence.</p>	<p>The City could be reminded to conduct toxicity testing in accordance with Licence requirements.</p> <p>See Comment ID ECCC 2, above, regarding meeting of parties.</p>

		<p>policy, Part D, Condition 2 and SNP, Part B, item 2 outline the toxicity testing requirements of MV2009L3-0007. It is noted that toxicity sampling was completed on 19 July 2017, and the results indicated a 100% survival rate for both Rainbow Trout and daphnia magna. However, based on the time series plots in the 2017 Annual SNP report (City of Yellowknife 2018), concentrations in July represent a timeframe when ammonia and total phosphorus concentrations were quite low compared to the remainder of the discharge period. It is recommended that acute testing also occur later in the year, when concentrations through the system are sustained at elevated levels. It may also be worthwhile to sample when pH levels are elevated, as ammonia toxicity increases with higher pH. It is also noted that SNP Part B, item 2 indicate that a toxicity sampling event shall be conducted twice a year, once at spring break-up and before freeze-up.</p> <p>Reference: City of Yellowknife. 2018. Water Licence MV2009L3-0007 - 2017 Annual Report. Submitted to the Mackenzie Valley Land and Water Board. March 2018. Mackenzie Valley Land and Water Board,</p>		
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		<p>Gwich'in Land and Water Board, Sahtu Land and Water Board, Wek'èezhìi Land and Water Board, and Government of the Northwest Territories. 2017. Guidelines for Effluent Mixing Zones. Yellowknife, NT. September 2017.</p> <p><b>Recommendation</b> Can the City complete the 2 annual toxicity sampling events, as required by MV2009L3-0007? Specifically, can the City include a sample later in the open water season, when pH/ammonia/phosphorus levels are elevated?</p>		
1 3	Initial Dilution Zone	<p><b>Comment</b> On page 5 of the Great Slave Lake Nutrient Assessment (Associated Environmental 2017), the Initial Dilution Zone (IDZ) appears to be set at 100 m from the discharge channel into Great Slave Lake. In the Guidelines for Effluent Mixing Zones (MVLWB et al. 2018) "the main use of a regulated mixing zone in the water licensing process is to define the point at which water quality objectives (WQOs) must be met." However, on page 20 of the Nutrient Risk Assessment, it is stated that the "action levels (objectives) for dissolved phosphorus and chlorophyll (collected 30 cm below surface approximately 300 m out from the inflow to the lake) beyond the outer</p>	<p><b>Oct 5:</b> MVLWB "Guidelines for effluent mixing zones" were adopted at the same time this report was finalized. The City will discuss the extent of the regulatory mixing zone and which water quality objective and action levels should apply with our consultant.</p>	<p>See Comment ID ECCC 2, above, regarding meeting of parties.</p>

		<p>boundary of the IDZ". It is unclear whether the City of Yellowknife intends to use 100 m as the extent of the regulatory mixing zone (p. 5), or 300 m (p. 20). References: Associated Environmental. 2017. Great Slave Lake Nutrient Risk Assessment. Prepared for the City of Yellowknife, December 2017. Mackenzie Valley Land and Water Board, Gwich'in Land and Water Board, Sahtu Land and Water Board, Wek'èezhì'i Land and Water Board, and Government of the Northwest Territories. 2017. Guidelines for Effluent Mixing Zones. Yellowknife, NT. September 2017.</p> <p><b>Recommendation</b> Can the City please clarify the extent of the regulatory mixing zone and where water quality objectives and action levels should apply?</p>		
1 4	Action Levels	<p><b>Comment</b> The argument for applying trigger ranges to DP rather than TP because of sediment resuspension from shallow (&lt;2 m deep) locations may be reasonable; however, there is uncertainty regarding background DP concentration along the shoreline (see above; all sites other than Site 7 appear to be affected by the discharge) and the second bullet on p. 21 is incorrect if using DP rather than TP. The text indicates that a single</p>	<p><b>Oct 5:</b> The statement in the report, which reads, "Any single measurement collected at 300 m from the discharge point to GSL (Site 3) should not exceed 0.055 mg/L." is correct.</p>	<p>Board Staff note that the City's response explicitly states that the action levels should apply at Site 3 (average of 4 samples &lt; 20 ug/L and no one value to exceed 55 ug/L). The average DP at Site 3 (Table 3-1) was 110 ug/L.</p> <p>Board Staff note that action levels be re-visited. A follow up question could re-iterate there seems to be an issue with the math and the 55 ug/L, and ask for the exact details of the calculation and application of the action level.</p>

		<p>measurement should not exceed 55 µg/L, representing a 50% increase of the average concentrations at the reference sites (per Table 3-4). Average DP concentrations are presented as 13.5 µg/L in Table 3-4; therefore, a 50% increase would equate to 20 µg/L. If this is the case, then the first bullet regarding the average of four samples is irrelevant, as any single measurement cannot exceed 20 µg/L. Further, the data are not consistent with designating Stations 4 through 7 as reference stations, which would drive the 50% increase down further.</p> <p><b>Recommendation</b> Can the City please confirm that the action level for dissolved phosphorus should read: Any single measurement collected at 300 m from the discharge point to GSL (Site 3) should not exceed 0.02 mg/L (20 µg/L), representing a 50% increase of the average concentrations at the reference sites (Table 3-4; per CCME 2004)?</p>		<p>See Comment ID ECCC 2, above, regarding meeting of parties.</p>
1 5	Action Levels	<p><b>Comment</b> None</p> <p><b>Recommendation</b> Would additional sampling allow the City to estimate background TP and DP concentrations along the shoreline in GSL?</p>	<p><b>Oct 5:</b> Additional sampling would be helpful, however the City is restricted by its budgets and staffing levels in how much sampling it can realistically achieve.</p>	<p>See Comment ID ECCC 2, above, regarding meeting of parties.</p>

<p>1 6</p>	<p>Action Levels</p>	<p><b>Comment</b> It is not clear whether an action level for nutrients would be triggered if either DP or chlorophyll A responses are observed, or if both are required to trigger. <b>Recommendation</b> Please indicate whether an action level for nutrients would be triggered if either DP or chlorophyll A responses are observed, or if both are required to trigger.</p>	<p><b>Oct 5:</b> If both chlorophyll A and dissolved phosphorus are exceeded, this would trigger a response. If only one is exceeded, this would trigger an action such as additional sampling, to determine the meaning of the exceedance - whether there is an ongoing problem or the exceedance sample was just an anomaly.</p>	<p>Board Staff noted that based on the response to comment #14, the City indicates the action levels would apply to samples at Site 3. The exact location for evaluating action levels is not well defined and should be clarified. The four chlor a results at Site 3 were (Table A-1): 12.8 ug/L (June) 12 ug/L (July) <b>21.8 ug/L (Aug) – so trigger (one sample &gt;15 ug/L)</b> 3.3 ug/L (Sept)</p> <p>Also at Site 3 – the avg of the 4 open-water DP was <b>110 ug/L</b> (Table 3-1) – <b>so trigger (avg &gt;20 ug/L and single measurement &gt;55 ug/L). Even if eliminate high value of 374 ug/L, the average &gt;20 ug/L.</b></p> <p>If following the AEMP guidance, the City would now need to set medium action level and outline course of action.</p> <p>Therefore, action levels require further discussion. Suggest setting interim values only at this time, until a larger dataset obtained.</p> <p>See Comment ID ECCC 2, above, regarding meeting of parties.</p>
<p>1 7</p>	<p>Action Levels</p>	<p><b>Comment</b> Typically, low action levels are set such that they are early warning indicators for change in the system. Given the previous 2 comments, the interpretation is that concentrations of DP should essentially be below the upper limit of the mesotrophic range (20 µg/L) by either 100 m or</p>	<p><b>Oct 5:</b> The City noted that one sample in September at site 3 had significantly higher dissolved phosphorus than the other site 3 samples. A one time exceedance such as this would not trigger a response plan, but would trigger an action,</p>	<p>Board Staff note that regardless of the sample of 374 ug/L, the average of the other 3 samples at Site 3 (23.9, 32, and 8.7 ug/L) was 21.5 ug/L, so the low action level would be triggered (based on bullet one under dissolved P on page 20).</p> <p>Board Staff note that a response plan can be as simple as the actions the City as outlined, including investigate further.</p>

		<p>300 m from the inflow. The Site description in Table 2-1 indicates that Site 3 is 300 m from the inflow. However, data in Table A-1 show that the average DP concentration at Site 3 is 110 µg/L, and individual DP results as far as Sites 4, 5 and 6 were above 20 µg/L. As such, the results from 2017 would have already triggered the action level for DP.</p> <p><b>Recommendation</b> Please revisit the action levels and develop clearer indicators of change in trophic status or protection.</p>	<p>such as additional sampling, to determine the meaning of the exceedance - whether there is an ongoing problem or the exceedance sample was just an anomaly.</p>	<p>Board Staff suggest a meeting with the City and their consultants to discuss Response Framework, action levels, and response plans.</p> <p>See Comment ID ECCC 2, above, regarding meeting of parties.</p>
18	Recommendations	<p><b>Comment</b> On p. 23 the report states: "For example, sampling the inflow near Site 6 and at least one other inflow outside of the influence of the FLTS during the recommended 2018-2019 monitoring program is recommended. This is to confirm that elevated phosphorus levels do not occur in similar uninfluenced streams. While it is unlikely that such elevated concentrations would occur in other streams, this would serve as a check that elevated phosphorus does not occur naturally in the region." This is a reasonable recommendation, but there is uncertainty regarding effects at Site 6, which suggests that sampling farther from the</p>	<p><b>Oct 5:</b> As previously stated, Dillon confirmed there is only one inflow path from FLTS to GSL. While additional studies and sampling would be useful, the City is limited in its budget and staffing levels to perform such a study. The City intends to continue sampling at sites 1 through 6 identified in this report beginning in 2019. It is expected sampling at these sites will provide adequate information on the effect of the FLTS on the receiving water body.</p>	<p>See Comment ID ECCC 2, above, regarding meeting of parties.</p>

		<p>inflow would be advisable to characterize background conditions, or along a gradient of increasing distances from the inflow stream along the shoreline. Based on concerns expressed regarding the study design and uncertainties related to results, additional study elements would also be worth considering: Sampling of the other inflow from the Fiddler's lake treatment system, more spatially extensive sampling and more distant reference area sampling.</p> <p><b>Recommendation</b> Can the City consider additional study elements for 2019: sampling of the other inflow from the Fiddler's lake treatment system, more spatially extensive sampling and more distant reference area sampling?</p>		
1 9	Treatment Options	<p><b>Comment</b> Overall, the recommended treatment options look reasonable and pragmatic for P. For N, it doesn't appear useful to pursue treatment (due to technical feasibility issues, general lack of ammonia concentrations of concern in the receiving waters, and expectation that GSL is P-limited). Given the information provided by the 2017 phosphorus study in GSL, the City's approach of proceeding with sludge removal and then re-assessing the P removal efficiency of the lagoon</p>	<p><b>Oct 5:</b> The City will consider reporting on new treatment efficiency, the ability to achieve the objectives for TP and ammonia, and anticipated next steps, once sludge removal is complete. It is anticipated that sludge removal will take at least 3 years to complete.</p>	See Comment ID ECCC 2, above, regarding meeting of parties.

		<p>are appropriate next steps. In order to better understand the longevity of the Fiddler's Lake Treatment System in its current state, further discussion/analysis focused on the effect of desludging on phosphorus removal in the context of triggers and thresholds could be presented to the Board.</p> <p><b>Recommendation</b> Once sludge removal is complete, will the City report on new treatment efficiency, the ability to achieve the objectives for TP and ammonia, and anticipated next steps?</p>		
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September 7, 2018

Erica Janes  
Regulatory Officer  
Mackenzie Valley Land and Water Board  
7<sup>th</sup> Floor – 4910 50<sup>th</sup> Avenue  
P.O. Box 2130  
Yellowknife, NT  
X1A 2P6

Dear Ms. Janes,

**Re: City of Yellowknife (the City)  
Water Licence – MV2009L3-0007  
Fiddlers Lake Treatment System Plan Version 2  
Request for Comment**

The Department of Environment and Natural Resources (ENR), Government of the Northwest Territories has reviewed the plan at reference based on its mandated responsibilities under the *Environmental Protection Act*, the *Forest Management Act*, the *Forest Protection Act*, the *Species at Risk (NWT) Act*, the *Waters Act* and the *Wildlife Act* and provides the following comments and recommendations for the consideration of the Board.

### **Topic 1: Triggers and Thresholds – Not Yet Provided**

#### **Comment(s):**

The current Risk Assessment Report is confirming changes in the Great Slave Lake (GSL) receiving environment by specifying that it would appear that phosphorus in this ecosystem has been accumulating over a long period of time, and that reducing potential effects of phosphorus enrichment downstream of Fiddler's lagoon will take time despite additional treatment. As such, treatment improvements may not reduce the phosphorus influx to Great Slave Lake for several years because of retention and release in the wetland/stream system downstream of the Fiddler's Lake Treatment System (FLTS). The report stated that phosphorus values monitored at SNP 0032- F1 were above guidelines 45% of the time in 2017, and that values as high as 12,7 mg/L were also found in the GSL receiving environment.

In response to the first submission of the Fiddler's Lake Treatment System Plan (FLTSP) V1, the MVLWB issued a letter to the City of Yellowknife dated November 19<sup>th</sup> 2015 which outlined specific Water Licence requirements that were then missing from the FLTSP, and should be included in the next version. Amongst details to be provided in V2 were triggers and thresholds, with actual numbers, including but not limited to treatment system performance criteria, timelines and loadings that would indicate when an upgrade to the Fiddler's Lake Treatment System would be required (as per Schedule 2, Item 3(a) of the Water Licence).

The City stated in the Fiddler's Lake Treatment System Plan V2 introduction letter, that they were unable at this time to provide the information on triggers and thresholds, as first requested in March 2012 (2009 Water Licence requirements), and again in the November 19, 2015 MVLWB letter. The City mentioned sludge removal plans to occur over several years, although no associated timeline were otherwise provided. Overall, triggers, associated responses and timelines to address/prevent eutrophication effects on the receiving environment through operations and maintenance actions such as sludge removal, improvements/upgrades to the system towards promoting long term health/efficiency of the FLTS and GSL receiving environment have not yet been provided.

ENR is concerned that establishment of triggers and thresholds to identify the need for upgrades to maintain the treatment capabilities and overall health of the Fiddler's drainage system (consequently extending its operating life) and its GSL receiving environment - were missing again from the latest version of the City's FLTSP.

### **Recommendation(s):**

- 1) ENR recommends that the City provide a timeline for establishing the triggers and thresholds requested by the Board.

### **Topic 2: Phosphorus Saturation in the Receiving Environment**

#### **Comment**

Section 3.3 of the report specifies that data from the City indicated that phosphorus levels from SNP 0032-F1 were similar to those measured in Site 1 of the GSL receiving environment, meaning that there was little attenuation of phosphorus for the last few kilometers of the stream. Furthermore, phosphorus levels were also elevated in Site 1 in June prior to release of wastewater effluent flow from the Fiddler's drainage system, indicating a systemic ongoing phosphorus supply to the GSL receiving environment, likely from long term storage of phosphorus due to inputs of municipal wastewater (as well as natural sources) over many years. The

*Associated Environmental Great Slave Lake Nutrient Risk Assessment* report concludes by stating that evidence of eutrophication beyond the local area was not detected based on measured levels of bioavailable forms of phosphorus (dissolved) and chlorophyll a, and that GSL as a whole would not be susceptible to eutrophication from FLTS considering its large area and volume.

Section 3.4 however, also concluded by stating that “Only a significant increase in phosphorus delivered to wider areas of the lake would cause a change in the trophic status outside the current receiving area. Any population growth in Yellowknife that results in significant increases in the volume of wastewater produced could result in such higher inputs over time.” ENR notes that the Fiddler’s Lakes Drainage System has been consistently contributing over ~8,100,000 L/day (or 8,100 m<sup>3</sup>/day) to Great Slave Lake since the early 90s (and earlier), and that the FLTSP (V1) projected increases to ~ 10,250 m<sup>3</sup>/day for 2031 were already surpassed from 2011 (11,795 m<sup>3</sup>/day) to 2014 inclusively (13,340 m<sup>3</sup>/day), as per information submitted in Annual Reports.

A 2017 report produced by the Canadian Water Network on Nutrient Management – Research Insights for Decision Makers specifies on p. 21 of 26 that there has been numerous knowledge advancements in the area of nutrient management over the last 10 or 15 years. Amongst key insights from the collective research identified as particularly relevant for developing effective nutrient-management policies and practices are that “Nutrient legacies may be critical to how the systems respond to management actions”, and “Timeframes between management actions and ecosystem responses can be very long.” The November 2015 Board letter to the City requested details on “action levels and response plans for ammonia and phosphorus, and a timeline for implementation.” Action levels were provided for a point located 300 m away from the inflow point into GSL. ENR is of the opinion that action levels and response plans should also be provided with concentrations within the FLTS, such as levels measured at SNP-0032-F1 and/or SNP-0032-F3, that would trigger the need for actions, such as de-sludging of the Fiddler’s lagoon.

**Recommendation(s):**

- 1) ENR recommends that the City provide details on action levels and response plans for phosphorus, to be established at a sampling point located within the FLTS before reaching the receiving environment of GSL, such as SNP 0032-F1 and/or SNP 0032-F3. In addition, ENR recommends that the City provide a timeline for implementation.

### **Topic 3: Treatment & Upgrades Options - Feasibility and Costs**

#### **Comment(s):**

Two options were suggested for phosphorus treatment, identified as 1) Phosphorus removal and 2) Nitrification. While chemical phosphorus removal would improve the phosphorus removal efficiency of the lagoon via chemical precipitation, it would also notably increase TSS concentrations which would in turn increase the rate of sludge accumulation and require electrical power and the erection of a new road. Nitrification was not further investigated as ammonia was deemed to not be an element of concern.

An Engineering analysis produced by Reid Crowther & Partners on *Performance and Improvement Strategies* for the City's Wastewater Treatment System (1990) was prepared in 1990 due to compliance issues of achieving treatment objectives EQCs at SNP 0032-F6 (e.g. see DIAND inspectors letter, July 1992). The compliance point initially located at SNP 0032-F6 (lagoon outlet – decant controlled discharge) was subsequently moved half way downstream in the FLTS to SNP 0032-F3 where no control on wastewater discharge is possible. This report also concluded constructing a second lagoon in the area of SNP 0032-F5 would increase the retention period from ~ 7-8 months to over 1 year, therefore optimizing wastewater treatment prior to being released into the wetland/drainage area.

#### **Recommendation(s):**

- 1) ENR recommends that the City act proactively and take the relevant steps and actions towards maintaining the health and treatment capabilities of their natural FLTS, to avoid further impacts to the receiving environment and within the FLTS itself.
- 2) ENR recommends for a timeline surrounding planned de-sludging actions of Fiddler's lagoon to be clearly outlined.

Comments and recommendations were provided by ENR technical experts in the Water Resources Division and the North Slave Region and were coordinated and collated by the Environmental Assessment and Monitoring Section (EAM), Conservation, Assessment and Monitoring Division (CAM).

Should you have any questions or concerns, please do not hesitate to contact Patrick Clancy, Environmental Regulatory Analyst at (867) 767-9233 Ext: 53096 or email [patrick.clancy@gov.nt.ca](mailto:patrick.clancy@gov.nt.ca).

Sincerely,

A handwritten signature in black ink, appearing to read 'P. Clancy', written in a cursive style.

Patrick Clancy  
Environmental Regulatory Analyst  
Environmental Assessment and Monitoring Section  
Conservation, Assessment and Monitoring Division  
Department of Environment and Natural Resources  
Government of the Northwest Territories



Environmental Protection Operations Directorate  
Prairie & Northern Region  
5019 52<sup>nd</sup> Street, 4<sup>th</sup> Floor  
P.O. Box 2310  
Yellowknife, NT X1A 2P7

ECCC File: 5200 000 001/004  
MVLWB File: MV2009L3-0007

September 7, 2018

Via online submission

Heather Scott  
Senior Technical Advisor  
Mackenzie Valley Land and Water Board  
7th Floor, 4922 48th Street  
P.O. Box 2130  
Yellowknife, NT X1A 2P6

Dear Ms. Scott:

**RE: MV2009L3-0007 – City of Yellowknife – Fiddlers Lake Treatment System Plan  
Version 2**

Environment and Climate Change Canada (ECCC) has reviewed the information submitted to the Mackenzie Valley Land and Water Board (MVLWB) regarding the above-mentioned Treatment System Plan and is submitting comments via the online review system. ECCC's specialist advice is provided based on our mandate, in the context of the *Canadian Environmental Protection Act* and the pollution prevention provisions of the *Fisheries Act*.

Should you require further information, please do not hesitate to contact me at (867) 669-4707 or [Bradley.Summerfield@Canada.ca](mailto:Bradley.Summerfield@Canada.ca)

Sincerely,

*[original signed by]*

Bradley Summerfield  
Senior Environmental Assessment Coordinator

Attachment(s): ECCC Comments Excel Sheet

cc: Georgina Williston, Head, Environmental Assessment North (NT and NU)