Recommended Quality Objectives for Municipal Effluent Discharging to the Lac La Biche Watershed

Prepared by:

Albert Liu, M.Sc. P. Eng.
Wastewater Engineer

And

Théo Charette, M.Sc.
Water Quality Specialist

Alberta Environment
Northern Region

November 16, 2006

Pub. No:
ISBN: (Printed Edition)
ISBN: (On-Line Edition)
Web Site: http://www3.gov.ab.ca/env/info/infocentre/publist.cfm

Any comments, questions, or suggestions regarding the content of this document may be directed to:

Northern Region
Alberta Environment
Twin Atria Building
111, 4999 – 98 Avenue
Edmonton, Alberta T6B 2X3
Phone: (780) 427-2265
Fax: (780) 427-7824

Additional copies of this document may be obtained by contacting:

Information Centre
Alberta Environment
Main Floor, Oxbridge Place
9820 – 106th Street
Edmonton, Alberta T5K 2J6
Phone: (780) 427-2700
Fax: (780) 422-4086
Email: env.infocent@gov.ab.ca

EXECUTIVE SUMMARY

This document describes recommended effluent quality objectives for municipal wastewater in the Lakeland/Lac La Biche (LLB) Region. Effluent from the LLB wastewater treatment plant has severely altered Field Lake, Red Deer Brook, and contributed to the deterioration of Lac La Biche. The existing technology-based effluent standards cannot satisfy the requirements to protect the Lac La Biche watershed. Thus, place-based effluent quality objectives were developed with key stakeholders to regulate the municipal effluent discharge to Field Lake and Lac La Biche. Recommended objectives are based on achieving the highest possible effluent quality, given current technology. The primary purpose of these objectives is to protect Field Lake and Lac La Biche.

ACKNOWLEDGEMENTS

Review comments were kindly provided by Preston McEachern, Rasel Hossain, Kem Singh, Bijan Aidun, Park Powell (AENV), Dr. Warren A. Wilson (senior wastewater consultant), and David Schindler (University of Alberta).

1.0 PURPOSE

This document describes recommended effluent quality objectives for municipal wastewater in the Lakeland/Lac La Biche (LLB) Region to ensure protection of the Lac La Biche Watershed. Lac La Biche is an important lake for drinking water, recreation, the local economy, and it is a historical site for the region. Because of the lake's importance, Alberta Environment (AENV), Northern Region Office, has developed these Municipal Wastewater Effluent Quality Objectives to be used as a recommended standard for the future Lakeland/LLB regional wastewater system upgrade. These recommended objectives are intended to provide direction to both AENV staff in review of Lakeland/LLB Regional Sewage Treatment and Disposal applications and in the development of discharge permit requirements. This document will also be made available to the regulated communities and their consultants to provide guidance for future facility planning. Overall, it is recommended that the effluent quality should achieve highly reclaimed wastewater with, at a minimum, the standards set forth in this document. Following these objectives will be a significant step to improving the quality of the Lac La Biche watershed.

2.0 BACKGROUND

2.1 The Existing Wastewater Treatment Plant

The Lac La Biche Wastewater Treatment Plant, in operation since 1983, is a three-cell aerated lagoon with a continuous discharge of approximately 2000 m^3/day to Field Lake, which discharges to Red Deer Creek and ultimately to Lac La Biche. The Plant currently treats sewage from the Town of Lac La Biche and is expected to increase its service area. Lakeland County is currently constructing a regional wastewater pipeline along the lakeshore eastward to Churchill Provincial Park and westward to the Hamlet of Plamondon. This pipeline will be connected to the Lac La Biche Wastewater Treatment Plant. The current wastewater treatment plant will be upgraded and become the Lakeland/LLB regional wastewater treatment plant.

2.2 Field Lake

Field Lake was part of a historical fur-trading route established by David Thompson in 1798, which linked the Churchill River to the Athabasca River via the Beaver River, Field Lake, two portages and Lac La Biche. Field Lake is located approximately 5 km south of the town of Lac La Biche and about 250 m north of the Beaver River. Currently, the lake is used as a "nutrient trap" to reduce the nutrient level of the final discharge to Lac La Biche. The use of Field Lake as a step in the treatment process was deemed the best alternative for nutrient reduction to protect Lac La Biche when the existing plant was constructed in early 1980s.

Since then, Field Lake has become highly nutrient-rich (i.e., hypereutrophic, mean summer 1997 [TP] = 1.6 mg/L) and today, the average phosphorus concentration is almost 30 times higher than those prior to plant operation (mean summer 1982 [TP] = 0.056 mg/L, Aquality, 2005). The effluent discharge led to severe water quality problems: blue-green algal blooms are frequent and

the lake is largely inhospitable to fish (i.e., dissolved oxygen levels deplete to zero during winter and ammonia toxicity is frequent according to the Canadian Water Quality Guideline for the protection of aquatic life; Mitchell 1998, Aquality 2005). Field Lake now has become a nutrient source to Lac La Biche (Schindler et al. 2004) and if the effluent qualities remain unchanged, the discharge will further deteriorate both Field Lake and Lac La Biche.

2.3 Lac La Biche

Lac La Biche has become highly nutrient-rich (i.e., hypereutrophic), has frequent odour and algal problems, and has a severely depressed fishery (Aquality 2004, Schindler et al. 2004). Because of public concerns over recreation and drinking water quality, improving the water quality of Lac La Biche is a priority issue for the town of Lac La Biche and Lakeland County. To protect the watershed for the future, the Lac La Biche Watershed Steering Committee is currently working on a Watershed Management Plan (Abdi Siad-Omar, Alberta Environment, personal communication).

The Owl River is the largest source of phosphorus to Lac La Biche. However, much of this phosphorus source is bound with materials that do not readily decompose. Sewage from the LLB wastewater treatment plant is one of the main sources of the water quality problems in Lac La Biche (Schindler 2004). Caffeine, an indicator of sewage, was detected entering Lac La Biche from Red Deer Brook (Aquality 2004). Because Red Deer Brook is affected by nutrients from sewage, the water quality in the lake is worst near the Red Deer Brook inflow. Phosphorus contributions from Red Deer Brook averaged 7% in 2003 and 9% (2004) of the input to Lac La Biche, but can reach as high as 20% in dry years (i.e., 1998 to 2002). In contrast to other sources, the phosphorus from Red Deer Brook is highly bio-available and is released in summer, the season when algal blooms occur.

3.0 EFFLUENT QUALITY REQUIREMENTS

3.1 Wastewater Treatment and Disposal Studies

Several wastewater disposal studies were conducted in the past two decades. Nutrient reduction was recommended in the previous studies (UMA, 1997). The most recent wastewater workshop was conducted in May 2005 with participation by various stakeholders and institutions, including University of Alberta, Alberta Environment, Alberta Sustainable Resource, nine consulting companies, Lakeland County, the Town of Lac La Biche, and local citizens including Mr. Tom Maccagno, who has been raising his concerns about Field Lake for a number of years. In this workshop, tertiary treatment with Biological Nutrient Removal (BNR) was recommended as the primary treatment option for future wastewater facility upgrades (Samuel, 2005), in order to protect Field Lake and Lac La Biche.

3.2 Effluent Criteria

The existing technology-based effluent standards cannot satisfy the requirements to protect the Lac La Biche watershed and the source of drinking water for the Lakeland/L.L.B. region. Place-based effluent quality objectives are proposed to regulate the municipal effluent discharge to Field Lake and Lac La Biche. Considering the significant water quality issues for Field Lake and Lac La Biche, the effluent quality for the future Lakeland/Lac La Biche regional wastewater treatment must be high. The future upgrade should continue to discharge to Field Lake and achieve a high level of reclaimed water quality, which will be high enough for any potential future use by nearby industry, landscaping, golf course irrigation, and other facilities.

Recommended quality specifications for effluent discharging to the Lac La Biche watershed are in Table 1. The overall target is to treat the regional wastewater to the highest reclaimed wastewater quality for both the protection of the receiving water bodies and to enable water re-use such as irrigation and industrial use. Treatment for water re-use is quite attractive as it enables the possibility of zero effluent discharge. Two references are used for the 5 CFU/100 mL fecal coliforms objective. One is USEPA recommended New Mexico Policy for the above ground use of reclaimed domestic wastewater. In this policy, a standard of 5 CFU/100 mL fecal coliforms was set for Class 1A reclaimed wastewater, which can be most broadly utilized except for direct consumption (New Mexico Environment Department 2003). The other reference is the quality specification of the Goldbar Wastewater Treatment Plant recycled membrane effluent, where the fecal coliform objective was set for 5 CFU/100 mL. Goldbar recycled membrane effluent is currently delivered to Petro Canada for its process water uses.

The recommended effluent quality objectives for total phosphorus and ammonia are higher than both the Alberta Water Quality Guidelines for the Protection of Freshwater Aquatic Life (1999) and the baseline (1982) nutrient concentrations in Field Lake, but they are the best that can be achieved at this time given current technology. This objective is, however, much lower than current nutrient concentrations in Field Lake. Because of nutrient accumulation in the sediments of Field Lake over the past quarter-century, it is expected that restoration of Field Lake will take decades. However, effluent discharging to Field Lake and with concentrations that follow recommended quality objectives will dilute and flush the excess nutrients from Field Lake and, over time, significantly reduce nutrient contributions to Lac La Biche itself. In addition, following these objectives will ensure that Field Lake is not exposed to any additional sources of fecal coliforms and suspended solids. High BOD criteria will also improve lake oxygen levels and ultimately, the potential for fish habitation.

Table 1. Recommended Effluent Quality Objectives for LLB Wastewater Treatment Plant. .

Parameter	Field Lake water quality before sewage discharge (summer 1982)	Quality of effluent discharged to Field Lake (2005 average)	Recommended effluent quality objectives
Total Phosphorus (mg/L)	0.056	NA	≤ 0.15
Ammonia-N (mg/L)	0.70	10.3	≤ 3
$CBOD_5$ (mg/L)	NA	11.9	≤ 5
Total Suspended Solids (mg/L)	6.2	16.9	≤ 5
Fecal Coliforms (# /100 ml)	NA	NA	≤ 5
Turbidity (NTU)	NA	NA	≤ 1
pH	8.4	NA	6.5 – 8.5

Notes: NA = data not available.

4.0 REFERENCES

Alberta Environment. 1999. Surface Water Quality Guidelines For Use in Alberta.

Aquality Environmental Consulting Ltd. 2004. State of the Lac La Biche Watershed 2004: Summary of Current Information. Report produced by Lakeland County.

Aquality Environmental Consulting Ltd. 2005. Field Lake Water Quality Assessment, January – Feburary 2005. Report produced by Lakeland County.

Michell, P. 1998. The Impact of Aerated Sewage Lagoon Effluent on Water Quality In Field Lake. Report produced by Alberta Environmental Protection. 21 pp.

New Mexico Environment Department. 2003. Policy for the above ground use of reclaimed domestic wastewater.

Samuel, G.B. 2005. Lac La Biche Wastewater Workshop Final Report. Report produced by Lakeland County.

Schindler, D.W., R. Freed, A. Wolfe, S. Neufeld, and R. Vinebrooke. 2004. Water Quality in Lac La Biche: A Preliminary Assessment of Past and Present Conditions. Report submitted to the Lac La Biche Watershed Steering Committee. 27 pp.

UMA Engineering Ltd. 1997. Town of Lac La Biche Wastewater Treatment and Disposal Study. 43 pp.