



October 15, 2004

Dear Engineer,

The purpose of this letter is to provide supporting documentation that shows the nitrogen removal capabilities of the Waterloo Biofilter system.

Nitrogen Removal with the Waterloo Biofilter

Introduction

Over the last few years, nitrogen removal has been a hot topic of concern in the on-site industry. Currently, under the Ontario Building Code there is no requirement for nitrogen removal. However, in systems above 10,000 L/day that are under the jurisdiction of the MOE, nitrogen removal is a factor. In order to evaluate a system's efficiency in the removal of nitrogen, it is important to understand the different forms of nitrogen that exist in wastewater.

Nitrogen in Wastewater

0 301.2 rTs4

1. TKN (Total Kjeldahl Nitrogen) = Organic-N + NH₃-N + NH₄-N
This form of nitrogen is referred as the total nitrogen that is in a chemically reduced form.
2. TN (Total Nitrogen) = TKN + NO₂-N + NO₃-N
This form of nitrogen is referred as the "true" total nitrogen that includes both chemically reduced and oxidized forms.

Nitrogen Removal with the Waterloo Biofilter Treatment System

Nitrogen removal with the Waterloo Biofilter Treatment System is accomplished through a series of biochemical reactions that occur in the septic tank and in the Biofilter medium. It is important to emphasize that the microbes that are responsible for nitrogen removal are very sensitive to temperature (cold weather), alkalinity (hardness) of the sewage and disinfectant chemicals that are added to the system.

The nitrogen removal process is illustrated in **Figure 1**. The process of nitrogen removal is as follows:

1. Septic tank effluent which is high in TKN (Organic-N + NH₃-N + NH₄-N) flows into a pump chamber and is dosed to the Biofilter. In this step TN ~ TKN because Nitrate and Nitrite (NO₂-N and NO

2. Reactions in Biofilter
NITRIFICATION

Waterloo Biofilter Third-Party Testing Data

Waterloo Biofilter Systems Inc. has done extensive testing to prove that the Biofilter can remove TN. Attached is a Data Summary of the 14-month extensive third-party field testing carried under the NSF-EPA ETV program. This test is quite stringent and results are published no matter how well or how poorly a system performs. These results show that the Waterloo Biofilter can remove ~60% TN in a double-pass system (with 50% recirculation).

Also attached is the ETI 24-month third party field testing results. These results show that the Waterloo Biofilter can remove ~40% TN in a single pass system (without recirculation).

The results from these third-party testing programs are posted on the Internet. For more details you can use the following links:

ETV Program - <http://www.epa.gov/etv/veri>

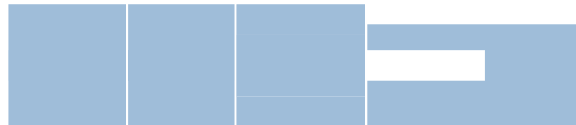
**Data Summary for Waterloo Biofilter[®] Model 4 Bedroom
Under the EPA ETV Water Quality Protection Center**

Effluent average of three Waterloo Biofilters with 50% recirculation For the 24-month period of June 1999 to July 2001

Test Results: These independent tests confirm that the Waterloo Biofilter can be loaded at very high rates and still obtain tertiary quality of $c+nBOD_5 = 8$ and $TSS = 4$ mg/L, with very low power consumption, and with ~60% total nitrogen removal. The actual loading rate is 330 USgpd dosed at household diurnal peaks, or a design of 10 gpd/ft³ (1200 L/m³) foam medium using a peaking factor = 2.0. Pan lysimeters showed that a 12" soil separation after the Biofilter[®] is equivalent to an underdrained 60" thick Title 5 sand filter system, but with much better nitrogen removal.

Benefits to Waterloo Biofilter Systems: After this testing, the Waterloo Biofilter is approved for General Use in Massachusetts and Provisional Use for Nitrogen Removal. All Massachusetts Health Departments will be advised of the test results; especially significant are the nitrogen results. Other New England states should not require multiple monitored pilots before approval, thus easing approvals for tertiary effluent credit and for nitrogen removal.

Substantial nitrogen removal in the Waterloo Biofilter[®]
is possible by re-circulation back to the septic tank.



Fecal coliform results for 12" lysimeter testing (25-30 samples):

	Lysimeter A1 May/00-Jul/01 cfu/100mL	Lysimeter A2 June/00-July/01 cfu/100mL	Lysimeter A3 June/00-July/01 cfu/100mL
Influent Sewage	3,700,000	3,800,000	3,700,000
After Waterloo & 12" of T=2 Sand	125	200	60
% Removal	99.99%	99.99%	99.99%

**Independent Single-Pass Testing (No Re-circulation)
On-going at Buzzard's Bay Test Facility, MA**

Waterloo Biofilter Single Pass Organics from Sept/01 to June/02:

	No. Samples	cBOD	TSS	DO	TN
Influent mg/L	37	214	130	0	37
Effluent mg/L	19	6.4	4.0	5.6	21.3
% Removal	-	97.0	96.9	-	42.5

T1 7 (a)TjETBT/TT1 3a(B)e9.18B42.5