

# On-site Wastewater Treatment System Environment Discharge Performance Appraisal

For the Devan Blue DB9000 NRS



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*Working with our communities for a better environment  
E mahi ngatahi e pai ake ai te taiao*



## Acknowledgements

Thanks to Andy Bainbridge, Dave Anderson and the rest of the team at the Rotorua District Council Wastewater Treatment Plant for their considerable effort in making this trial possible.



## Disclaimer

This document reports on the measured ability of the wastewater treatment system to reduce the concentration of a range of wastewater parameters. No testing was performed on the integrity, capacity or durability of this system.

For further information refer to:

- AS/NZS 1546.1:1998 – On-site domestic wastewater treatment units Part 1: Septic tanks.
- AS/NZS 1547:2000 – On-site domestic wastewater management.
- AS/NZS 1546.3:2001 – On-site domestic wastewater treatment units Part 3: Aerated wastewater treatment systems.



## Summary

The **Devan Blue DB9000 NRS** wastewater treatment system had influent and effluent monitored every six days over a nine month period. The best performing 16 consecutive samples (over about three months) within this was used for evaluating nitrogen reduction. Three blocks of seven consecutive days (week 8, 16, and 25) were also sampled to determine carbonaceous biochemical oxygen demand, and total suspended solids.

Effluent discharged from this treatment system was found to comply with Environment Bay of Plenty's standard for installation in the Bay of Plenty region outside the Rotorua lakes' catchment.

**This system may be installed anywhere in the Bay of Plenty region, excluding the Rotorua Lakes' catchments, provided all conditions in rule 12 of the On-site Effluent Treatment Regional Plan are met.**

It also performed within the limits set by Environment Waikato for the Taupo catchment.

Before choosing a wastewater system it is recommended that power consumption and maintenance requirements are carefully considered.
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## 1 Introduction

Excessive levels of nutrients in waterbodies are a known risk factor for their eutrophication. One source of these nutrients, particularly nitrogen, is from on-site wastewater treatment systems.

Many local authorities are interested in an assessment of the effectiveness of advanced (aerobic) wastewater treatment systems (compared to conventional septic tanks) for where no reticulated sewerage system exists. Some regional plans, eg. Environment Bay of Plenty and Environment Waikato, specify levels of treatment required by advanced wastewater treatment systems. Many other areas are likely to follow as water quality comes under increasing pressure.

A trial site was established at the site of the Rotorua wastewater treatment plant in 2005 to measure advanced wastewater treatment system performance. From 2005 to July 2007 fourteen different systems have been trialled. Another round of trials commenced November 2007.

This report presents the results for one of the trialled systems. Reports on the other systems are available at the Environment Bay of Plenty website [www.envbop.govt.nz](http://www.envbop.govt.nz)

## 2 System information

### System Name/Model:

Devan Blue DB9000 NRS

### Manufacturer and Supplier:

Devan Blue Limited

## 3 System specifications

Supplier	System	Rated Flow (l/day)	Tanks Operating Capacity*	Treatment Technology
Devan Blue Ltd	DB9000 NRS	1000	Primary Tank: 1400 litres  Aeration & clarification & recirculation:  3800 litres	Suspended growth / packed bed filter

\*In addition to this there is emergency storage of 1400 litres.

## 4 Testing Regime

Untreated wastewater from Rotorua City's eastside sewer was screened before passing into a header tank from which influent was delivered to a number of wastewater treatment systems. Influent was pumped to the systems twice daily by positive displacement pumps operating from a single variable speed drive. The loading regime was intended to be approximately 1000 litres per day per system, with two thirds of the load delivered between 6 am and 11 am every morning and the balance between 6 pm and 9 pm at night. This regime was designed to simulate typical household usage.

The daily flow varied throughout the period largely due to the pumps being unable to reliably handle the raw influent and some blockages occurring.

Samples of influent and effluent were taken at about six day intervals for:

<ul style="list-style-type: none"> <li>• pH and alkalinity</li> <li>• ammonium-nitrogen (NH<sub>4</sub>-N)</li> <li>• nitrate-nitrogen (NO<sub>3</sub>-N)</li> <li>• nitrite-nitrogen (NO<sub>2</sub>-N)</li> </ul>	<ul style="list-style-type: none"> <li>• total kjeldahl nitrogen (TKN)</li> <li>• total oxidised nitrogen (TOxN)</li> <li>• total nitrogen (TN)</li> <li>• total phosphorus (TP)</li> </ul>
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In addition to the regular interval sampling, there were three, seven consecutive day blocks of samples. These were analysed for the above parameters plus the following: carbonaceous biochemical oxygen demand (CBOD<sub>5</sub>), total suspended solids (TSS) and faecal coliforms (FC).

Analysis was performed by the Rotorua District Council Environmental Laboratory (IANZ accredited) in accordance with "Standard Methods for the Examination of Wastewater", APHA, AWWA, WPCF.

Effluent from each wastewater treatment system was discharged into a 20 litre container placed within a 200 litre drum, from where it returned to the sewer. The drums were filled intermittently depending upon the individual system characteristics.

Samples were taken from the 20 litre container. This ensured that completely fresh samples were taken every time. Temperature of the effluent was measured in the outflow collection drums.

## 5 Test Results

Flow to the Devan Blue DB9000 NRS wastewater treatment system commenced on 16 October 2006. Sampling occurred from 26 October 2006 through to 26 July 2007.

The TN evaluation period is from 24 February 2007 through to 1 June 2007. This is a period of 98 days. Nitrogen test results are based on data from sampling about every six days over the evaluation period. The above period was chosen for TN evaluation of this system as it reflects the best TN reduction performance over 16 consecutive samples.

The average measured flow to this system over the TN evaluation period was 863 litres per day, excluding three 'no flow' days (refer to table 4).

Table 1 displays total nitrogen influent and effluent results for the evaluation period. The average TN in the effluent over this period was 18.8gm<sup>-3</sup>. Based on the average of the 98 day TN evaluation period result, the system reduced nitrogen by 76%.

Table 1 Summary of total nitrogen results over the TN evaluation period

Date	Day	Influent (gm <sup>-3</sup> )	Effluent (gm <sup>-3</sup> )	Parameter	Influent (gm <sup>-3</sup> )	Effluent (gm <sup>-3</sup> )
24-Feb-07	1	96.4	21.0	n	16	16
2-Mar-07	7	69.4	15.1	mean	79.8	18.8
8-Mar-07	13	162.4	11.8	median	81.1	18.6
14-Mar-07	19	109.3	14.7	SD	30.6	4.0
20-Mar-07	25	50.7	15.9	Max	162.4	25.0
26-Mar-07	31	94.1	14.5	Min	38.0	11.8
1-Apr-07	37	45.0	14.4	lower quartile	60.5	15.0
10-Apr-07	46	91.2	20.3	upper quartile	94.7	22.2
20-Apr-07	56	65.0	22.7			
26-Apr-07	62	100.0	18.9			
2-May-07	68	63.8	18.3			
8-May-07	74	85.2	24.3			
14-May-07	80	77.0	25.0			
20-May-07	86	38.0	22.0			
26-May-07	92	38.0	23.6			
1-Jun-07	98	91.0	18.2			
<b>Average</b>		<b>79.8</b>	<b>18.8</b>			
<b>Average TN Reduction</b>		<b>76%</b>				

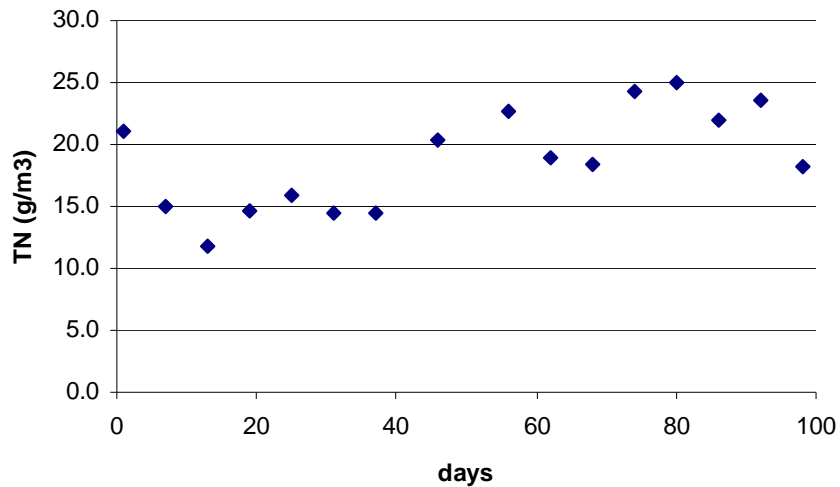


Figure 1 Graph of total nitrogen results over the TN evaluation period

## 5.1 CBOD<sub>5</sub><sup>1</sup>, Faecal Coliform and TSS Test Results

Three one week (7 day) duration test periods at week 8, week 16, and week 25 were delineated for testing CBOD<sub>5</sub>, TSS, FC and TN.

Table 2 Average influent and effluent results over seven days for weeks 8, 16 and 25

Influent	CBOD5 (gm <sup>-3</sup> )	FC (cfu/100mL)	TSS (gm <sup>-3</sup> )	TN (gm <sup>-3</sup> )
Wk 8	532	1.5 X 10 <sup>7</sup>	1692	70.1
Wk 16	246	3.7 X 10 <sup>7</sup>	705	78.9
Wk 25	423	2.8 X 10 <sup>7</sup>	1768	105.8

Efluent	CBOD5 (gm <sup>-3</sup> )	FC (cfu/100mL)	TSS (gm <sup>-3</sup> )	TN (gm <sup>-3</sup> )
Wk 8	9.6	2.0 X 10 <sup>5</sup>	11	16.3
Wk 16	3.8	2.8 X 10 <sup>4</sup>	17	31.2
Wk 25	4.0	3.4 X 10 <sup>4</sup>	13	15.0

Efluent	CBOD5 (gm <sup>-3</sup> )	FC (cfu/100mL)	TSS (gm <sup>-3</sup> )
Mean	6.1	9.0 x 10 <sup>4</sup>	14
Median	5.0	4.0 x 10 <sup>4</sup>	13
SD	3.5	18.9 x 10 <sup>4</sup>	5
n	18	20	18
Minimum	0.5	1.1 x 10 <sup>4</sup>	7
Maximum	14.0	88.0 x 10 <sup>4</sup>	26
Lower Quartile	4.0	2.4 x 10 <sup>4</sup>	10
Upper Quartile	8.3	8.1 x 10 <sup>4</sup>	16

<sup>1</sup>Note that the CBOD values are likely to be lower than those presented in table 2, due to treating results lower than the detection limit as being at the upper limit of detection.

## 5.2 Other Results

Table 3 Statistics for nutrient data over the TN evaluation period

	TP (gm <sup>-3</sup> )	NH <sub>4</sub> -N (gm <sup>-3</sup> )	NO <sub>3</sub> -N (gm <sup>-3</sup> )	NO <sub>2</sub> -N (gm <sup>-3</sup> )
Mean	8.7	7.3	8.4	0.30
Median	8.6	7.6	8.3	0.28
SD	0.9	6.0	2.2	0.15
n	16	16	16	16
Minimum	7.0	0.4	5.5	0.03
Maximum	10.2	16.1	13.1	0.63
Lower Quartile	8.1	1.1	6.6	0.21
Upper Quartile	9.5	11.9	9.7	0.37

## 5.3 Electricity Consumption

Electricity consumption of the Devan Blue DB9000 NRS wastewater treatment system averaged 2.7 kWh per day over the 98 day TN evaluation period.

There was a 0.75 kWh irrigation pump present during the trial.

## 5.4 Daily Volume

Each system had a water meter to measure the daily volume of treated effluent discharged. Table 4 below shows the flow statistics for this system<sup>2</sup>.

Table 4 Statistics for daily flow data over the TN evaluation period

	litres per day
Mean	863
Median	883
SD	260
n	94
Minimum	0
Maximum	1311
Lower Quartile	763
Upper Quartile	1039
Number of 'no flow' days ignored	3

Note:

Some 'no flow' days for all systems were caused by the pump controller failing to re-set after power failures. These 'no flows' were ignored for the purpose of calculating Table 4. Any other 'no flow' days unique to a particular system, caused by a blockage etc, were included.

<sup>2</sup> Measurements made by the system manufacturer recorded a maximum flow of 1747 litres occurred on 17 April 2007. No official flow measurement was made on this day.

## 6 Compliance Statement

The Devan Blue DB9000 NRS wastewater treatment system met the performance requirements for operating as a permitted activity within Bay of Plenty Region, excluding the Rotorua Lakes' catchments. It also performed within the limits set by Environment Waikato for the Taupo catchment.

Over a 98 day TN evaluation period the average level of TN in the effluent was  $18.8\text{gm}^{-3}$ . Over this period the total nitrogen was reduced on average by 76 percent.

CBOD<sub>5</sub> and TSS maximum results were both well below Environment Bay of Plenty permitted maximums of  $30\text{ gm}^{-3}$  and  $45\text{ gm}^{-3}$  respectively.

The compliance statement relates only to the particular model described above, and on the basis that the key specifications are the same as those in the model tested. This includes tank and chamber volumes, re-circulation rates, and textile/film total surface area.

## 7 Compliance Standard

The performance standard for on-site wastewater treatment systems are based on the rules stated in Environment Bay of Plenty's Operative On-site Effluent Treatment Regional Plan 2006.

Discharges from on-site effluent treatment systems located within the Rotorua Lakes Catchments are described by rules 11 and 13 as a permitted activity provided that:

The effluent quality of systems after a maximum settling in period of six months does not exceed:

- a total nitrogen (TN) level of 15 grams per cubic metre as nitrogen;
- 30 grams per cubic metre of CBOD<sub>5</sub> and;
- 45 grams per cubic metre of suspended solids; prior to discharge to the dispersal system.

For installations outside Rotorua catchments the nitrogen limit does not apply.

Refer to rules 12 and 13 for compliance details for installations of new on-site wastewater treatment systems in the Bay of Plenty.

For confirmation of any details in this report please contact Sam Weiss at:

Environment Bay of Plenty  
5 Quay Street, P O Box 364  
Whakatane, New Zealand

Ph. 0800 ENV BOP (368 267)





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## Appendix – Performance Certificate



# Performance Certificate



EXCLUDES ROTORUA CATCHMENTS

Company:	<b>Devan Blue Ltd</b>
Address:	<b>PO Box 2602, Tauranga</b>
Model Number:	<b>Devan Blue DB9000 NRS</b>
Manufacturer rated daily flow (litres)	<b>1000</b>
Total operating capacity, including pump chamber (litres)	<b>5800</b>
Primary tank (litres)	<b>1400</b>

This is to certify that the **Devan Blue DB9000 NRS** wastewater treatment system supplied by **Devan Blue Ltd** is considered to meet the requirements of rule 12(f) of the Operative On-Site Effluent Treatment Regional Plan 2006. Therefore it may be installed as a permitted activity in the Bay of Plenty, anywhere **outside the Rotorua Lakes Catchments**, provided that all other requirements of rule 12 are met.

The certification relates only to the particular model described above, on the basis that the key specifications are the same as those in the model tested at the Rotorua trial facility. This includes tank and chamber volumes, re-circulation rates, and media total surface area.

For any questions about this certificate please contact Sam Weiss on 0800 368 267.

**Note:** In order to comply with Regional Plan requirements Environment Bay of Plenty must be provided with written confirmation that a system has been installed to the manufacturer's specifications and that it fully meets the requirements of rule 12.

A handwritten signature in black ink, appearing to read 'S. Weiss'.

**Sam Weiss**  
Project Implementation Officer  
Environment Bay of Plenty

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Expiry date: 1 September 2012