APPENDIX 6

Wastewater Treatment and Disposal Report

NZET
CONSULTING ENGINEERS

Guinea Trust – Flat Point subdivision – Stage 2

Wastewater Treatment and Disposal

DATE: 26 August 2008
PROJECT: C99018

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REPORT STATUS: Final

TABLE OF CONTENTS

Page

2: Description of the Proposal

2.1 The Site.

The site is in the area known as Flat Point, located 41 km to the south east of Carterton on the eastern Wairarapa Coast. The site location and layout is shown below. Stage 1 was approved for subdivision in 2000, and development started in 2001. Of the 39 lots in stage 1, 35 have been sold. As of May 2008 there were 19 houses constructed or under construction, of which 2 were permanently occupied.

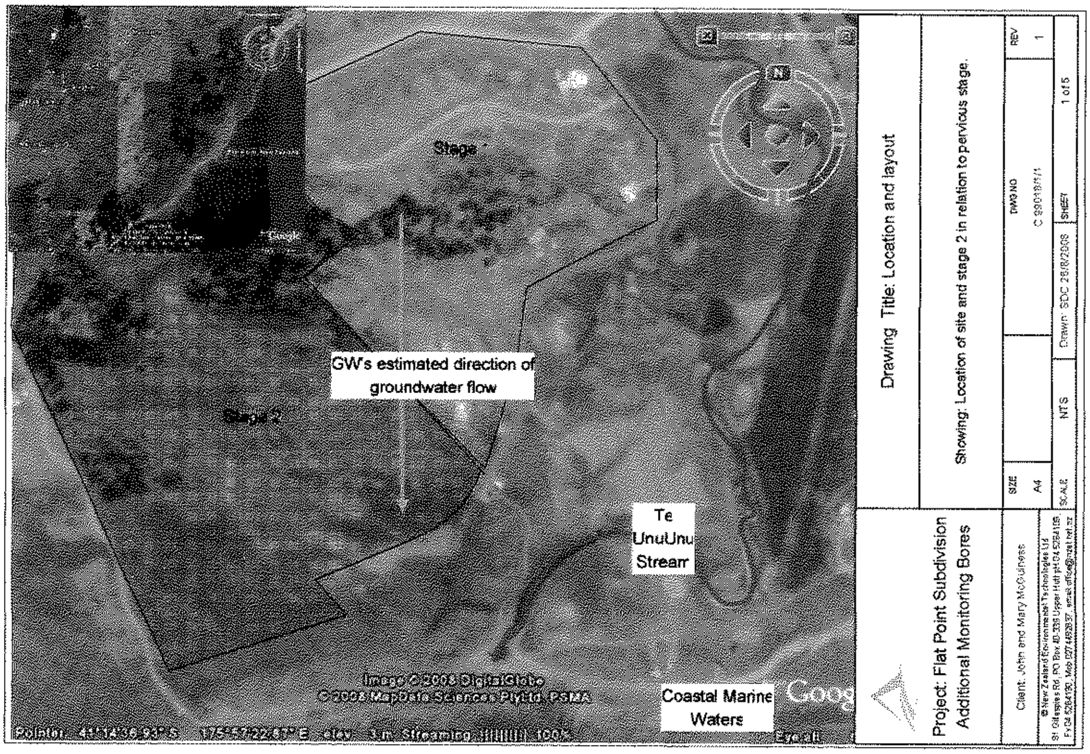


Fig 1: Locality Plan

2.2 Soils Investigations

The stage 2 area of some 10.6 Ha, was investigated with 5 test pits, to supplement the information obtained from the 13 test pits undertaken on stage 1. The pit location for all test pits is shown in figure 2 below.

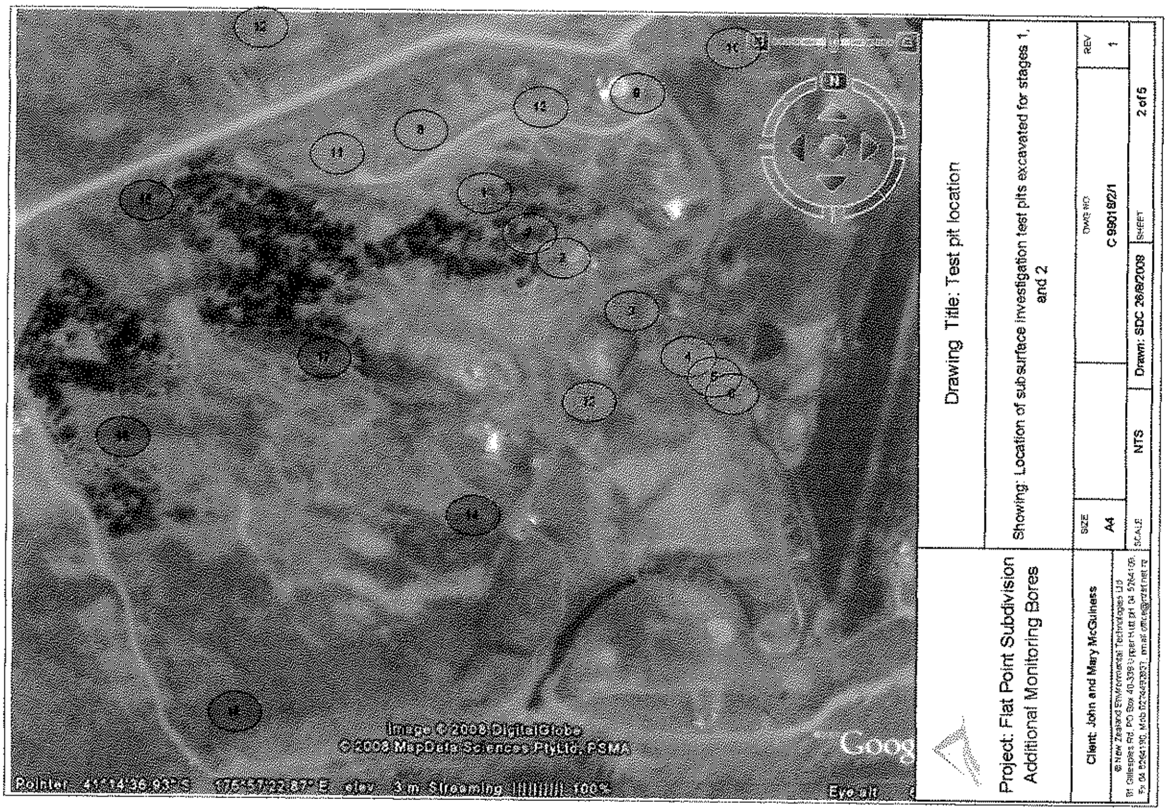


Figure 2 Test pit location, (stage 1 (green) and 2 (purple))

Soil profiles in the stage 2 area were found to be similar to stage 1, with some 200-300mm of a light sandy topsoil, overlying sands to 900-2200mm +, overlying beach deposits (shell, pebbles), overlying a mudstone base. From Flat point Road at the top of Figure 2, the water table shows a relatively steep gradient in excess of 1:100, directly towards the coast.

The NZLRI worksheet series map for the area classifies the soils as VIIIe4: coastal foredunes, windblown dune sand. Further inland the underling rock type is shown as mudstone and siltstone. Depth to water table is predominantly dictated by the depth to the beach deposit / mudstone interface.

Typical soils from various depths in the 5 test pits have been analysed for; existing moisture content at the time of sampling, field saturation moisture content, and particle size grading, by wet sieve analysis. The results of these tests are given in Annex A .

2.3 Monitoring.

The site has been monitored over the period of the development with sampling from three stream sites and 6 groundwater sites. Summarised monitoring data in graph form is attached to this report in Annex B.

Monitoring of the stage 2 development is proposed using two additional monitoring bores and the existing stream monitoring sites.

Monitoring to date has shown no measurable impact on ground water or stream quality from stage 1 of the development.

The location of the existing and proposed new groundwater monitoring bores is shown in Figure 3 below. The stream sites are upstream of bridge, (the bridge where flat point road crosses the Te Unu Unu Stream), at the bridge, and downstream of the bridge.

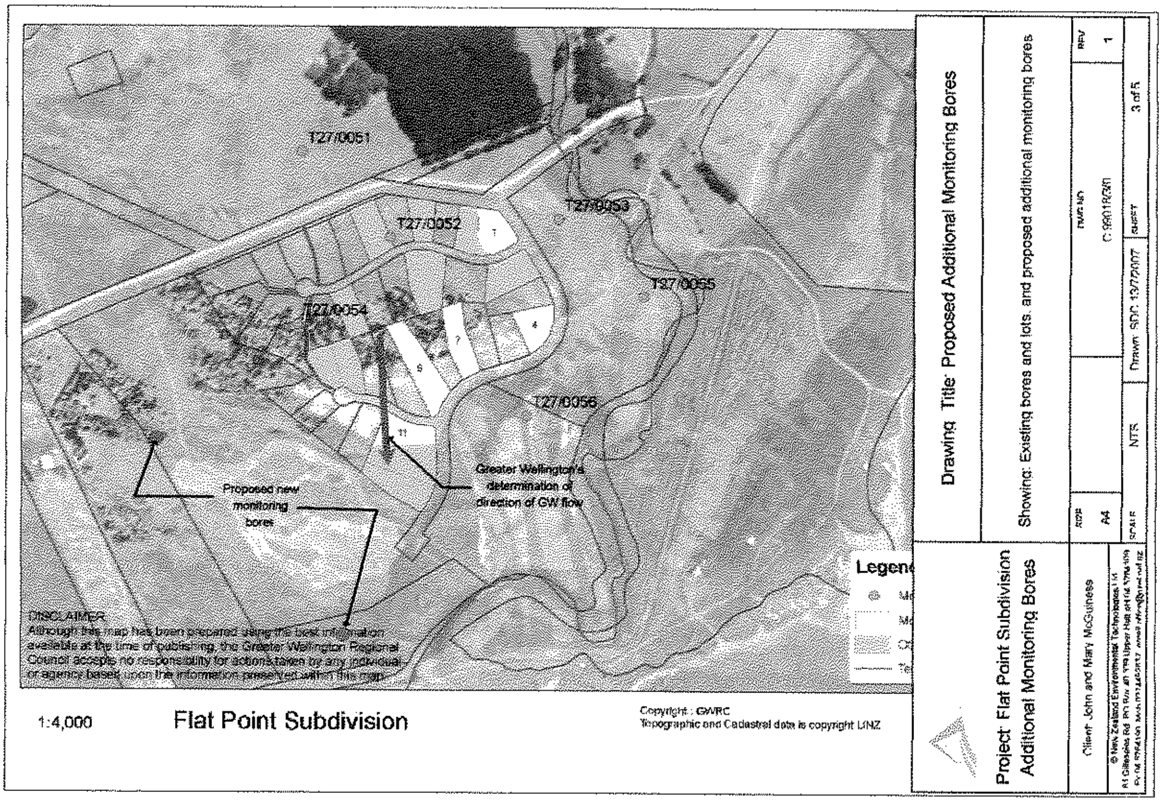


Figure 3. Existing development on stage 1 and location of existing and proposed groundwater monitoring sites.

2.4 Design Flows

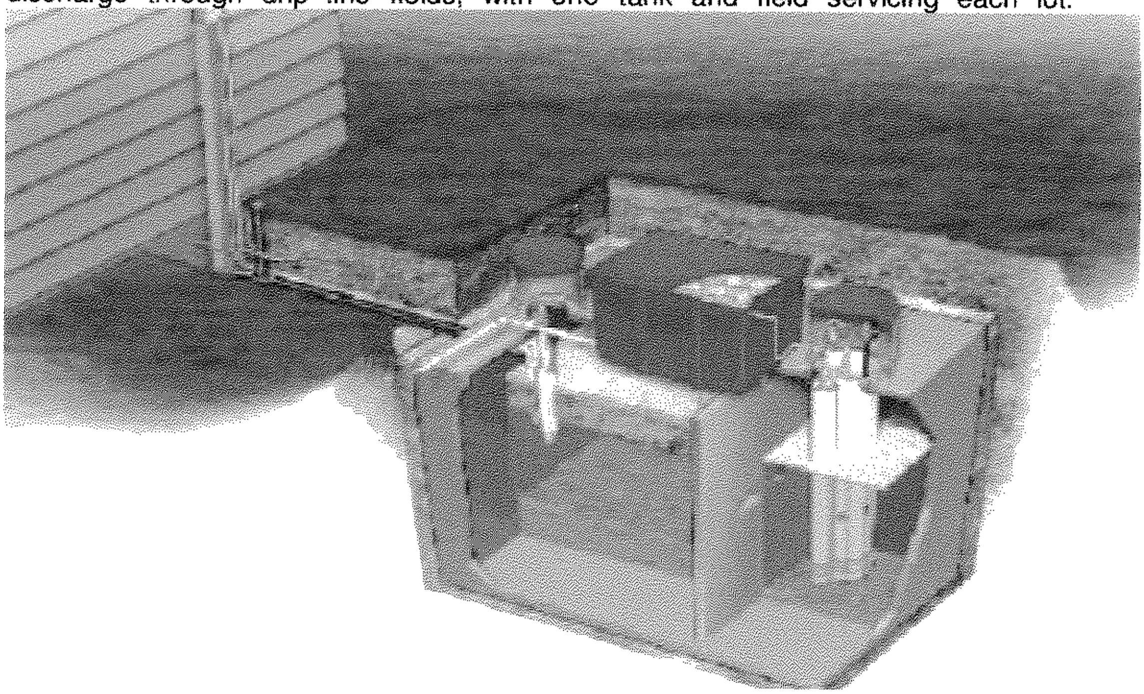
The assumptions used to determine the design flows are tabulated below.

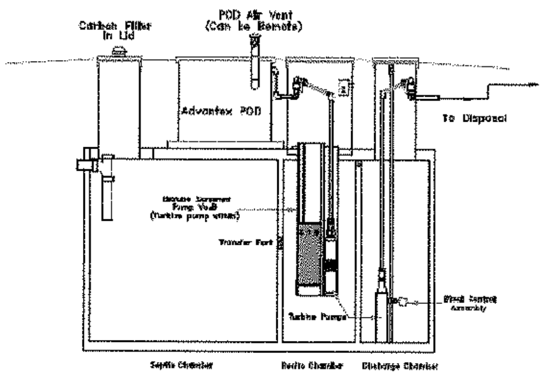
# Lots	Assumed Maximum Population (based on 5 persons / lot)	Maximum discharge to land (m3/d) (based on 160 Litres/person/day
42	210	34

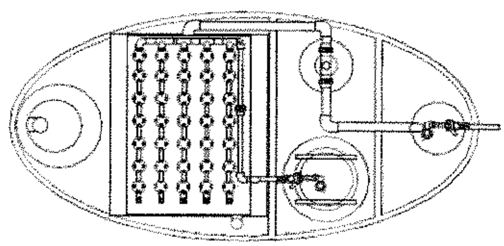
Table1. Design Wastewater Flows

2.5 Proposed Treatment

Current estimates are that the maximum sewage flow produced by 42 occupied lots will be 34m3/d. It is proposed to capture this in sealed, below ground treatment units which discharge through drip line fields, with one tank and field servicing each lot.







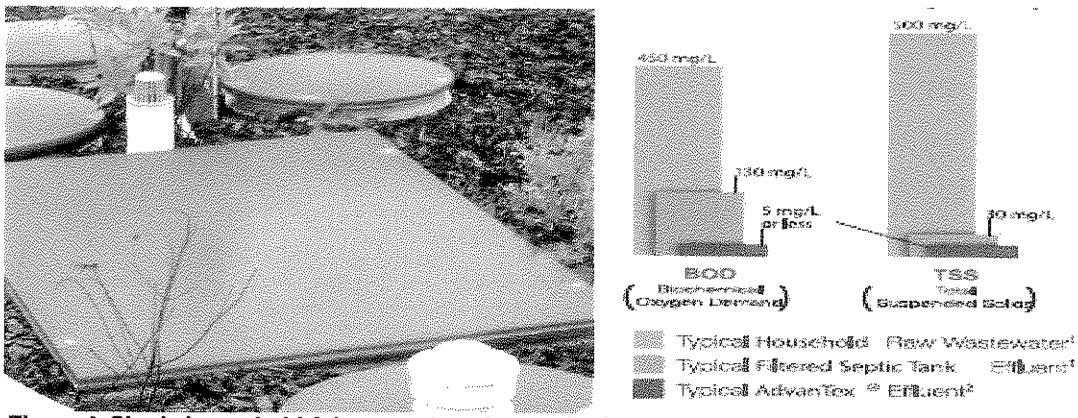


Figure 4. Single household Advantex plant; isometric view, Top), plan view, (centre right), elevation view, (centre left), appearance of access lids, (bottom left), and performance comparison (bottom right).

A close up view of the Advantex Textile Reactor System is shown below. Microbes grow on both the textile elements and within the liquor in the tank. This system, whilst expensive, has the advantages that there is very little maintenance required, the treated effluent quality is very good, (really to tertiary standards), and it can better cope with both low loads for extended periods and high loads for shorter periods, without a significant deterioration in effluent quality, than most other processes.

Fig 5: Interior of Advantex Textile Reactor

Effluent from the treatment plant is to be discharged to land by pressure compensated drip line irrigation; with drip lines located at 1m centres and laid on the ground surface. The drip lines will be laid out over an area on each lot which will be determined by the number of bedrooms the dwelling has. This will vary from 100m2 for a 1 bedroom dwelling to 200m2 for a 4 bedroom dwelling.

The proposed dripline is to be surface laid, which places it at the top of the topsoil layer. After a short period of time, however, it has been found that such an installation will be covered with wind blown sand and vegetation. Further that laying the lines in this manner reduces the extent of problems with sand being sucked in through the drip emitter when the pump switches off. Surface installation allows for high levels of moisture uptake by surface drying, capillary attraction, and transpiration from the plants. After a matter of months, the lines become buried as shown below, providing adequate protection from surface loads and disturbance.

The dripline field area corners will be marked and referenced to the site boundaries and it is not anticipated that any additional constraints would be required for the area.

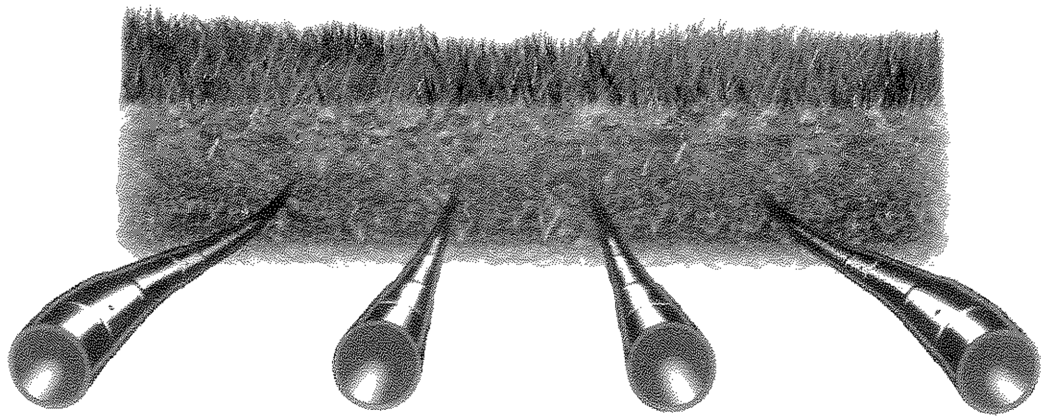


Figure 6. Typical appearance of subsurface discharge drip line several months after laying.

2.6 Effluent Quantity

The quality of effluent from the tertiary treatment and land treatment systems is predicted to be as tabulated below. Also shown are existing background levels in the ground and stream waters, as monitored by GW and NZET.

Cointaminant	E coli	NH3	NO3	DRP	BOD	SS
Treatment Plant Effluent	50000.0	1.0	15.0	8.0	10.0	10.0
Unsaturated Soil Zone Effluent	50.0	0.5	10.0	7.0	1.0	1.0
Upstream groundwater current levels	5.0	0.5	1.0	0.3	1.0	1.0
Following 10:1 dilution in ground wtaer	9.1	0.5	1.8	0.9	1.0	1.0
Stream current levels	120.0	0.0	0.002	0.2	2.0	2.0
Following 1000:1 dilution in stream water	119.9	0.0	0.004	0.2	2.0	2.0

Table 2. Effluent quality compared to receiving water quality, (groundwater and stream)

3 Discharge Consents

3.1 Discharge Contaminants to Land

As the proposed wastewater system is based on an on-site treatment plant and disposal field for each dwelling, complying with Rule 6 (e) and Rule 7 of the Wellington Regional Plan for Discharges to Land, this is a permitted activity and no consents are required.

3.2 Discharge Contaminants to Air

Rule 21 of the Wellington Regional Air Quality Plan specifically allows the discharge of contaminants to air from sewage treatment and disposal, provided it is discharged on the site on which it is generated, and there is no discharge of odour, gas, vapour or aerosol which is noxious, dangerous, offensive or objectionable at or beyond the boundary of the property. The operation of the on site wastewater plants and disposal fields is therefore a permitted activity and no air discharge consent is required.

4: Assessment of Effects on the Environment

4.1 Discharges to Land

4.1.1 Potential Effects of the Proposed Discharge to Land

The proposed discharge is to land, although residual flows and contaminants from the discharge will at times enter the groundwater and ultimately the surface water of the Te Unu Unu Stream near its point of discharge to the sea.

A cross section of the disposal field is shown below.

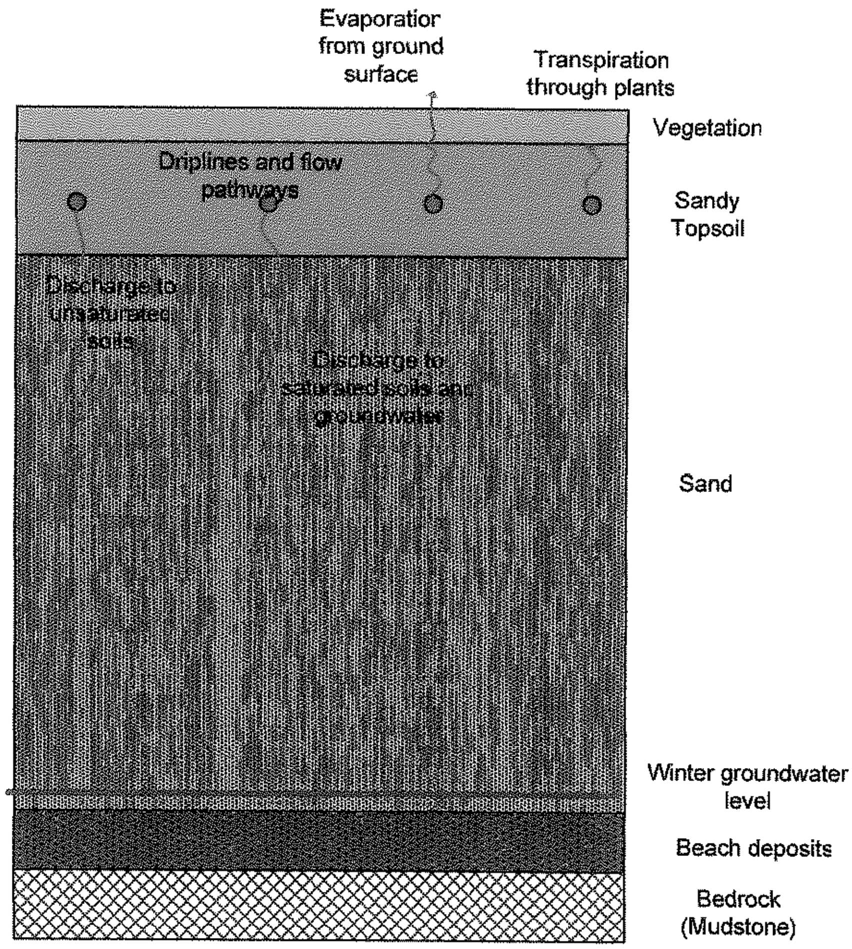


Figure 7. Pathways for irrigated effluent.

In order for the system to operate as designed, the passage of the required flows must be able to be sustained by the soil. Interpretation of the soil particle size analyses, (refer

Appendix A), gives acceptable effluent loading rates, (from NZS 1547:2000), of 35mm/week at a depth of 200-400mm. Based on typical meteorological data, (Annex D), even at this loading rate, it is likely that there will be no discharge to groundwater from November through to February inclusive.

The final issue is the degree of renovation, which occurs in passing the effluent through the soil. The input contaminant levels here are the discharge quality from the treatment plant. In this instance, the slow passage through fine-grained soils is of great advantage in renovating the effluent. A minimum soil passage flow path of 1 m of unsaturated soil is assumed.

The calculated residual values of contaminant levels in receiving waters, (ground and stream), are tabulated below, along with an analysis of the increase (if any) created by the discharge and, for the one parameter, nitrates, which are predicted to create a significant increase, a comparison with the ANZECC guideline value for TON, (predominantly nitrates) from an upland stream, (which is much higher). The stream below the subdivision area also flows directly to the sea with substantial dilution once the stream and sea waters mix, thereby minimising any impact from the predicted increased nitrate levels.

Contaminant	E coli (cfu/100ml)	NH3-N (g/m3)	NO3-N (g/m3)	DRP (g/m3)	BOD (g/m3)	SS (g/m3)
Treatment Plant Effluent	50000	1	15	8	10	10
Unsaturated Soil Zone Effluent	50	0.5	10	7	1	1
Upstream groundwater current levels	5	0.45	1	0.25	1	1
Following 10:1 dilution in ground wtaer	9.1	0.5	1.8	0.9	1.0	1.0
% change in ground water quality	81.82	1.01	81.82	245.45	0.00	0.00
Stream current levels	120.00	0.03	0.002	0.22	2.00	2.00
Following 1000:1 dilution in stream water	119.89	0.03	0.004	0.22	2.00	2.00
% change	-0.1	1.4	90.7	0.3	0.0	0.0
ANZECC 2000 Upland River			0.167 (TON)			

Table 3. Impact of contaminant levels in receiving waters.

Therefore, the discharge of contaminants from the on site systems is predicted to either cause a negligible change to receiving water contaminant levels, or, with the one parameter where a significant increase is predicted, a negligible impact.

4.1.2 Proposed Means of Mitigating Effects of Discharge to Land

As the discharge to land is predicted to cause negligible changes or impacts, no further mitigation, (in addition to the high quality treatment cited in the application), is proposed.

It is also worth noting that the predicted impacts are with maximum occupancy, an unlikely scenario as development and occupancy to date on stages 1 and 2 have shown.

4.2 Discharges to Air.

4.2.1 Potential Effects of the Proposed Discharges to Air

There was little information found on the air quality in the area, other than anecdotal evidence that, with reasonable wind runs and the nature of surrounding activities, it is likely to be of a "typical" nature for rural New Zealand.

The wind rose for the nearest monitoring station, (East Taratahi), and the mean wind speed for Castlepoint, show that the wind direction is variable and reasonably consistent throughout the year, refer to table 4 and figure 8 below.

Direction	Mean Annual % of Time Wind is From Direction
N	7.1
NE	14.6
E	2.9
SE	1.6
S	4.6
SW	15.1
W	13.2
NW	7.3
Calm	33.4

Table 4. Wind Rose – East Taratahi

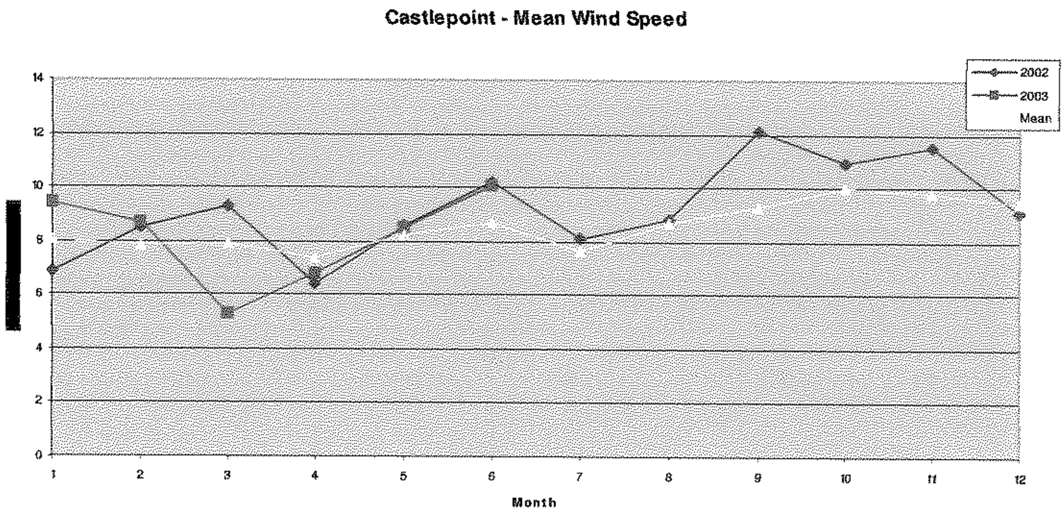


Figure 8. Mean Wind Speed Castlepoint.

Odour

The discharge of sewage from individual house tanks, and the dripline, could potentially contain a number of gases from sewage and its anaerobic decomposition.

Some of the main gases likely[2], to be formed in the sewerage and sewage treatment systems are; hydrogen sulphide, ammonia, oxygen, carbon dioxide, methane, nitrogen and hydrogen. Some of these, and other gases, which may be present in trace amounts, have the potential to cause offensive odours. The main constituents of this odour-causing group are listed below[1]:

Gas	Threshold Odours Concentration ppm (vol/vol)
Carbon disulphide	0.21
Acetaldehyde	0.21
Hydrogen Sulphide	0.00047
Nitrogen Compounds	0.00021-100.0
Skatoile	0.019
Mercaptans	
Ethyl	0.001-0.00026
Methyl	0.041-0.0021
Ammonia	46.8
Perchlorethylene	4.68
Phenol	0.6

Table 4. Potential Odours in Sewage Systems

The only one of these potential gaseous contaminants which has specified concentrations in the WRC's Discharges to Air Plan[3], is hydrogen sulphide at maximum desirable value of 1ug/m3 and a maximum acceptable value of 7ug/m3.

Given the sealed nature of the anaerobic components of the system, (on site tanks and raw wastewater reticulation system), the aerobic and sealed nature of the treatment system, and the excellent track record that this type of system has, it is contended that the odour risk is low and only likely to occur, for an individual tank, for a short duration in the event of a significant mechanical breakdown.

4.2.2 Proposed Means of Mitigating Adverse Effects of Discharge to Air

Discharges to air will occur from on-site tanks and discharge lines. The system is aerobic, and will be vented through via the drains and drain terminal vent through the house system. If necessary, the tank vents can be fitted with activated carbon filters to minimize odours. No significant aerosols are expected, as the treatment vessels are covered and the dripline low flow and will be subsurface.

5: Proposed Management and Monitoring

It is proposed to manage and monitor the system in the following manner;

- ☐ Regular, (annual), inspection of the treatment tanks, to monitor performance as well as sludge and scum levels. These results to be reported annually to the Carterton District Council. . This will be undertaken by an approved agent of the process supplier.
- ☐ An alarm panel is located on each tank. This will cause an audible and visual alarm when high tank water levels occur. As there will only be flow to the tank when the properties are occupied, property owners will have a simple response check list, and a comprehensive reference manual, and if this does not rectify the problem, a maintenance visit can be arranged for the same or next day through the system agents.
- ☐ As part of confirming that the environmental impact is as per this proposal, it is recommended that ground and surface water monitoring be undertaken at the same time as the onsite system maintenance occurs. This is proposed to be annual monitoring of the stream and bore qualities, with timing recommended to be in March. The parameters proposed for monitoring are; E coli bacteria, ammoniacal and nitrate nitrogen, and total phosphorus. Sampling would be by the onsite system agent, and analysis by an independent analytical laboratory. Sampling would be subject to water availability as during some dry periods at some sample locations there has historically been no water.

For the onsite wastewater system requirements, the same consent conditions as we used in stage 1 of this development are proposed:

15. An approved wastewater treatment and disposal system to satisfy condition 14 above will comply with the following:

15.1 The system will comply with the requirements of Rules 6 and/or 7 of the Regional Plan for Discharges to Land (operative – December 1999).

15.2 The minimum treatment performance standards for any installed treatment system shall be:

Carbaneous BOD_5	< 10 g/m^3
Suspended Solids	< 10 g/m^3
Ammonical Nitrogen	< 2 g/m^3
Nitrate Nitrogen	< 30 g/m^3
Faecal Coliforms	< 2000 cfu/100ml,

provided that installation shall include a two-week period on start up, during which time the effluent quality for some parameters may fall outside these limits.

15.3 There shall be no wastewater or seepage from wastewater visible at the ground surface.

15.4 Disposal fields with sub-surface emitters to be no less than $200m^2$, with each field being located and determined within each lot by an appropriately qualified person.

15.5 System design and location of disposal fields to be approved by the Regional Council prior to installation. This condition to be secured by a consent notice pursuant to section 221 of Resource Management Act 1991 in respect of each title.

16. The installation of the approved wastewater treatment and disposal systems is to include the following:

16.1 Treatment systems and emitter lines to be installed by an appropriately qualified person approved by the manufacturer.

16.2 Sub-surface emitters are to be installed and maintained between a minimum depth of 150mm, and a maximum depth of 250mm below the ground surface. Spacing between emitters and spacing between emitter lines to be no more than 1.0 metre.

16.3 Treatment systems and alarms are to be independently electrical wired to a master switch, as opposed to the mains switch, to ensure continuous operation.

16.4 A manufacturers producer statement to be supplied following satisfactory installation and commissioning to the District Council.

16.5 The disposal field for each lot shall be identified on the Survey Plan in such a manner that its location can be readily established on the ground with reference to the boundaries of the lot concerned.

16.6 The disposal field for each lot shall be identified with appropriate ground marking, which shall include at least one permanent low post, which has been concreted in place, with a metal plate showing the location of the disposal field. This condition to be secured by a consent notice pursuant to section 221 of Resource Management Act 1991 in respect of each title.

16.7 Appropriate measures are to be taken to prevent compaction or damage to both the treatment system and disposal field.

16.8 An appropriate owner's manual is to be provided to each lot owner prior to treatment system use, and thereafter retained at each dwelling. The owner's manual is to include the location of the treatment plant and disposal field and any alterations, and is to detail the treatment system and disposal field operations, maintenance, monitoring requirements, expected water quality and potential health risks. The owner's manual shall also contain a clear statement that the owner will be required to justify any performance monitoring results in excess of the stipulated levels, and undertake remedial actions to return a non-complying system to required levels. The owners manual is to meet the approval of the District Council and the Regional Council.

17. The approved wastewater treatment and disposal systems are to be operated and maintained as follows:

17.1 No alteration to the disposal field (including relocation or diversion) to be made without prior approval of the District Council.

17.2 Any approved alteration of a disposal field to be accompanied by changes to the consent notice and metal plate as provided for under condition 16.6, and the owners manual under condition 16.8.

17.3 Each treatment system and disposal field to be subject to an annual inspection carried out under a service contract by an appropriately qualified person approved by the manufacturer and the District Council.

17.4 Annual inspections to be conducted between the period 1 November to 31 March (inclusive).

17.5 An annual Certificate of Fitness is required for each treatment system and disposal field, certifying that the system meets the performance standards and other criteria specified under conditions 15 and 16 of this consent, including that the owner's manual is up to date and available, and the maintenance requirements specified by the manufacturer have been undertaken.

17.6 Maintenance and repair of the treatment system and disposal field is required prior to the Certificate of Fitness being issued.

6: Alternatives to the Proposal

The proposed system basically represents "state of the art" technology for on-site sewage treatment and disposal to minimise environmental impact. Therefore, most alternatives represent lower quality outcomes. Those which have been considered and rejected are;

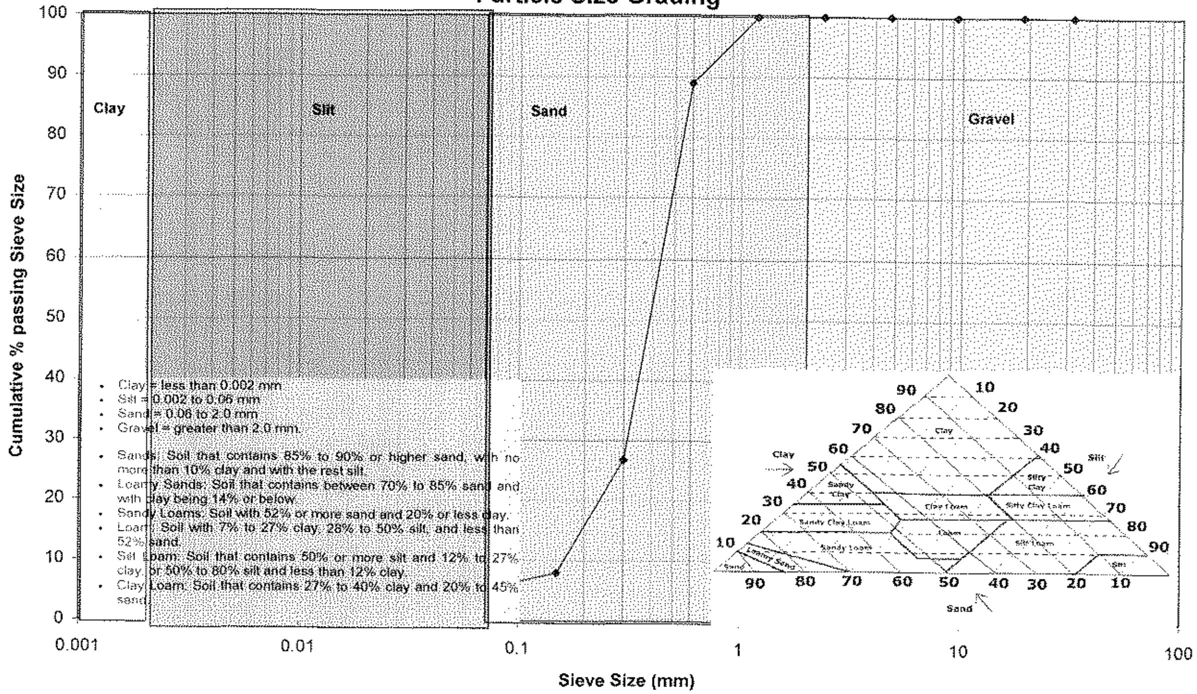
- ☐ Lower quality on site treatment systems. Even though there are a number of more economical systems which could comply with the Discharges to Land Plan rules, these were not favoured as the desire is to have a "high quality" system representing state of the art technology and creating minimal impact.
- ☐ High quality community treatment, with direct discharge to surface water. This could possibly be undertaken at lower overall cost, but was rejected because the philosophy of this development is that the community will dispose of its own wastes in an acceptable manner and on its own land. It is also not favoured at policy level under the Regional Freshwater Plan.
- ☐ High quality community treatment with spray Irrigation or subsurface disposal on areas such as the golf course. This is not favoured as the growth and occupancy of the settlement has been sporadic and operating a larger treatment facility with such variable loading would be difficult. Spray irrigation would also not be favoured due to aesthetic concerns from nearby property owners, and subsurface irrigation on the golf course limits the extent to which good turf culture practices can be applied.

To illustrate the performance of the Advantex system, an independent trail of on site wastewater systems seeking approval for use within nutrient enriched or sensitive areas such as Lakes Taupo and Rotorua has been undertaken and the results are reported in Appendix C. This shows the Advantex system out performed others especially with respect to nitrogen removal and also had significantly lower power consumption.

Appendix A: Soil Test Results.

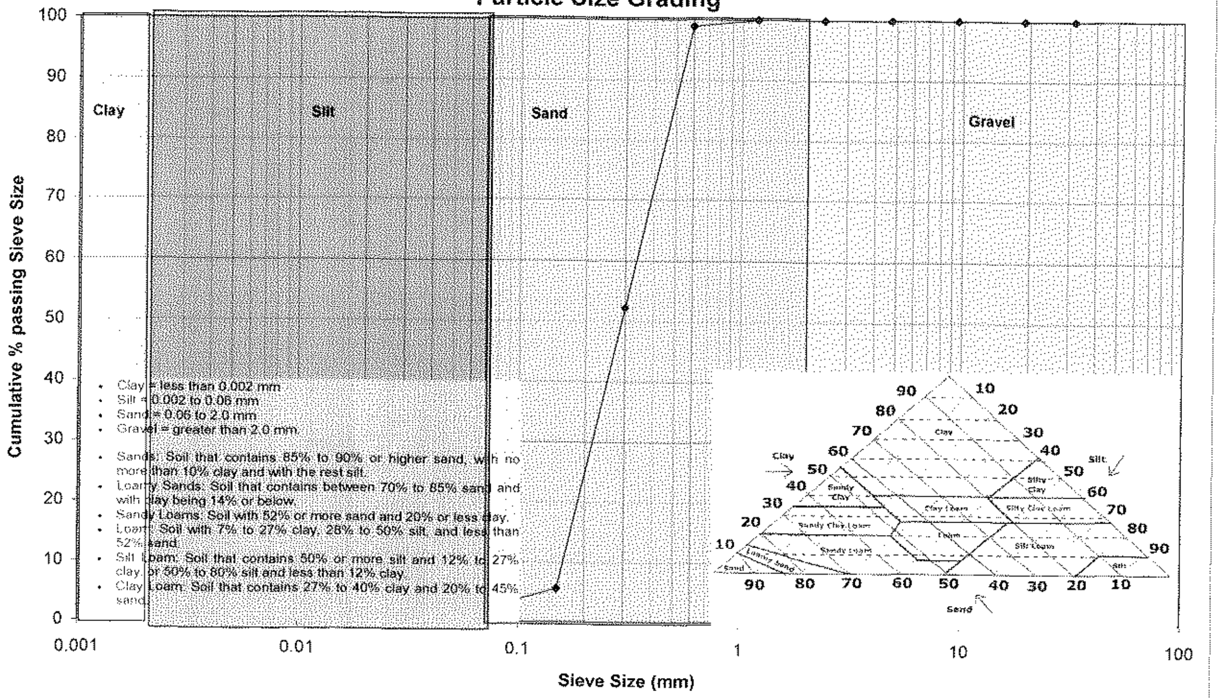
Particle Size Grading Worksheet - Job Number: C99018 Sample: - Hole: 18 @600 Date Sampled: 8/5/2008 Date Analysed: 14/5/2008 Analyst: RV			
Weight of wet sample + container			
Weight of dry sample + container =	950	**Sample Description:**	
Weight of Container =	494	sand	
Weight of dry sample =	456		
Weight of water =			
Moisture Content % =	4.54		
Field capacity as % mc	17.82		
Sieve aperture size	**Cumulative Weight Retained**	**Cumulative Weight Passing**	**Cumulative % passing**
32	0	456	100
19	0	456	100
9.5	0	456	100
4.75	0	456	100
2.36	0	456	100
1.18	0	456	100
0.6	50	406	89.03508772
0.3	334	122	26.75438596
0.15	420	36	7.894736842
0.063	434	22	4.824561404
Total	456	0	0

Mc Guiness Flat Point - Hole 18@600
Particle Size Grading

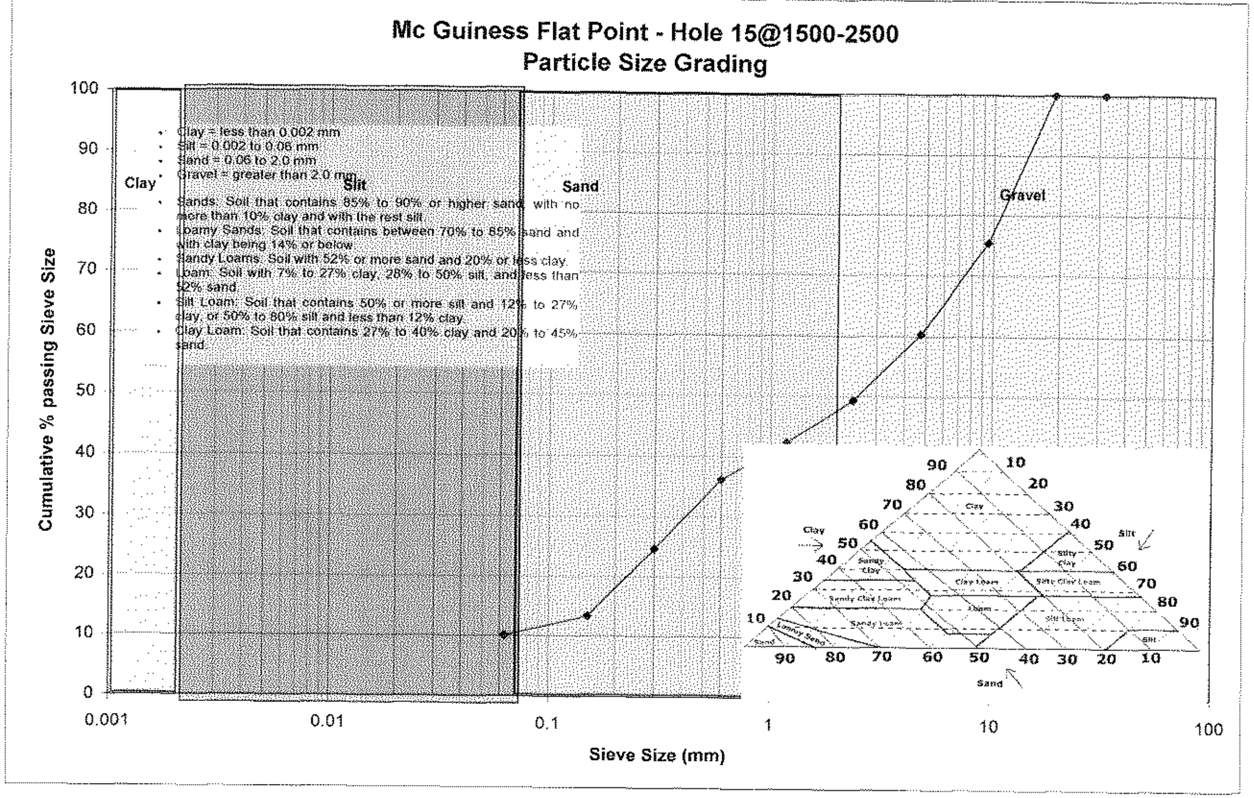


Particle Size Grading Worksheet - Job Number: C99018 Sample: - Hole: 17 @200 Date Sampled: 8/5/2008 Date Analysed: 14/5/2008 Analyst: RV			
Weight of wet sample + container			
Weight of dry sample + container =	672	**Sample Description:**	
Weight of Container =	494	sand	
Weight of dry sample =	178		
Weight of water =			
Moisture Content % =	4.95		
Field capacity as % mc	19.15		
Sieve aperture size	**Cumulative Weight Retained**	**Cumulative Weight Passing**	**Cumulative % passing**
32	0	178	100
19	0	178	100
9.5	0	178	100
4.75	0	178	100
2.36	0	178	100
1.18	0	178	100
0.6	2	176	98.87640449
0.3	85	93	52.24719101
0.15	168	10	5.617977528
0.063	175	3	1.685393258
Total	178	0	0

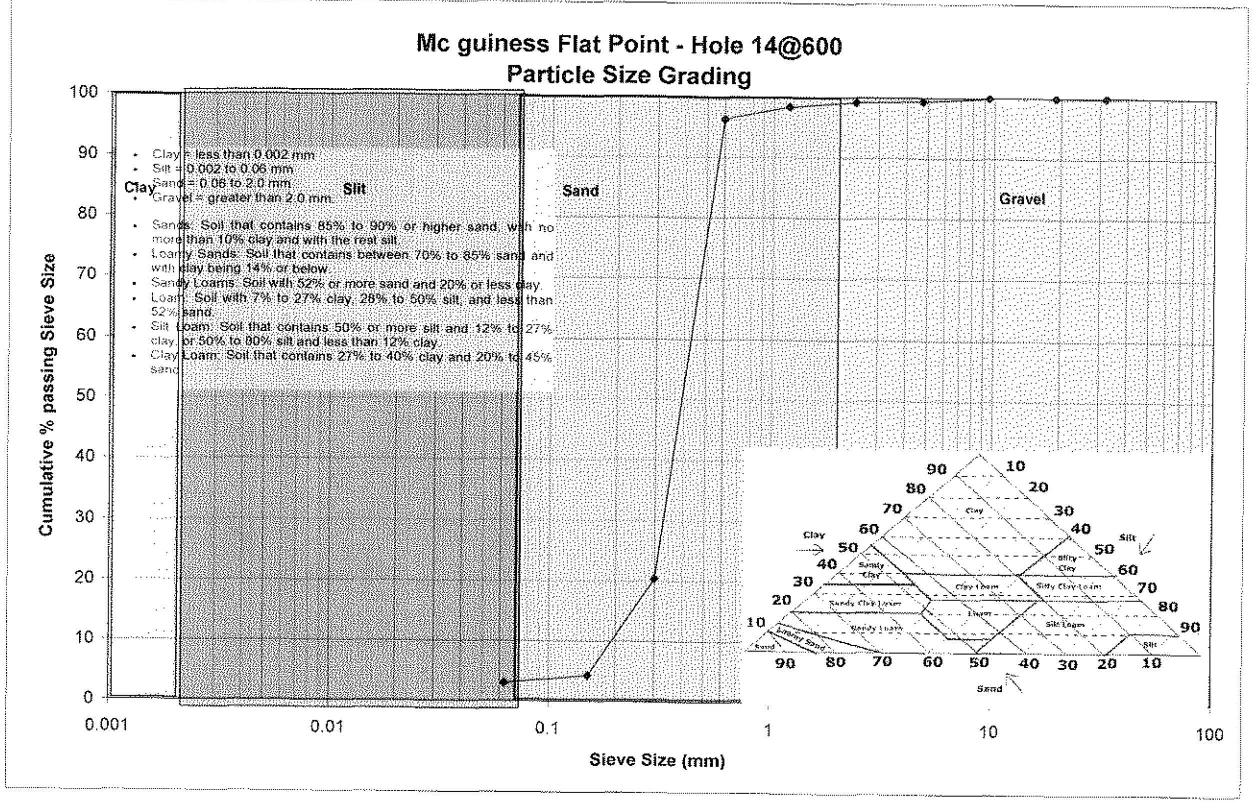
Mc Guiness Flat Point - Hole 17@200
Particle Size Grading



Particle Size Grading Worksheet - Job Number: C99018 Sample: - Hole: 15@1500-2500 Date Sampled: 8/5/2008 Date Analysed: 14/5/2008 Analyst: RV			
Weight of wet sample + container			
Weight of dry sample + container =	439	**Sample Description:**	
Weight of Container =	111		
Weight of dry sample =	328		
Weight of water =			
Moisture Content % =	4.60		
Field capacity as % mc	17.9		
Sieve aperture size	Cumulative Weight Retained	Cumulative Weight Passing	Cumulative % passing
32	0	328	100
19	0	328	100
9.5	81	247	75.30487805
4.75	130	198	60.36585366
2.36	166	162	49.3902439
1.18	189	139	42.37804878
0.6	209	119	36.2804878
0.3	247	81	24.69512195
0.15	284	44	13.41463415
0.063	295	33	10.06097561
Total	328	0	0

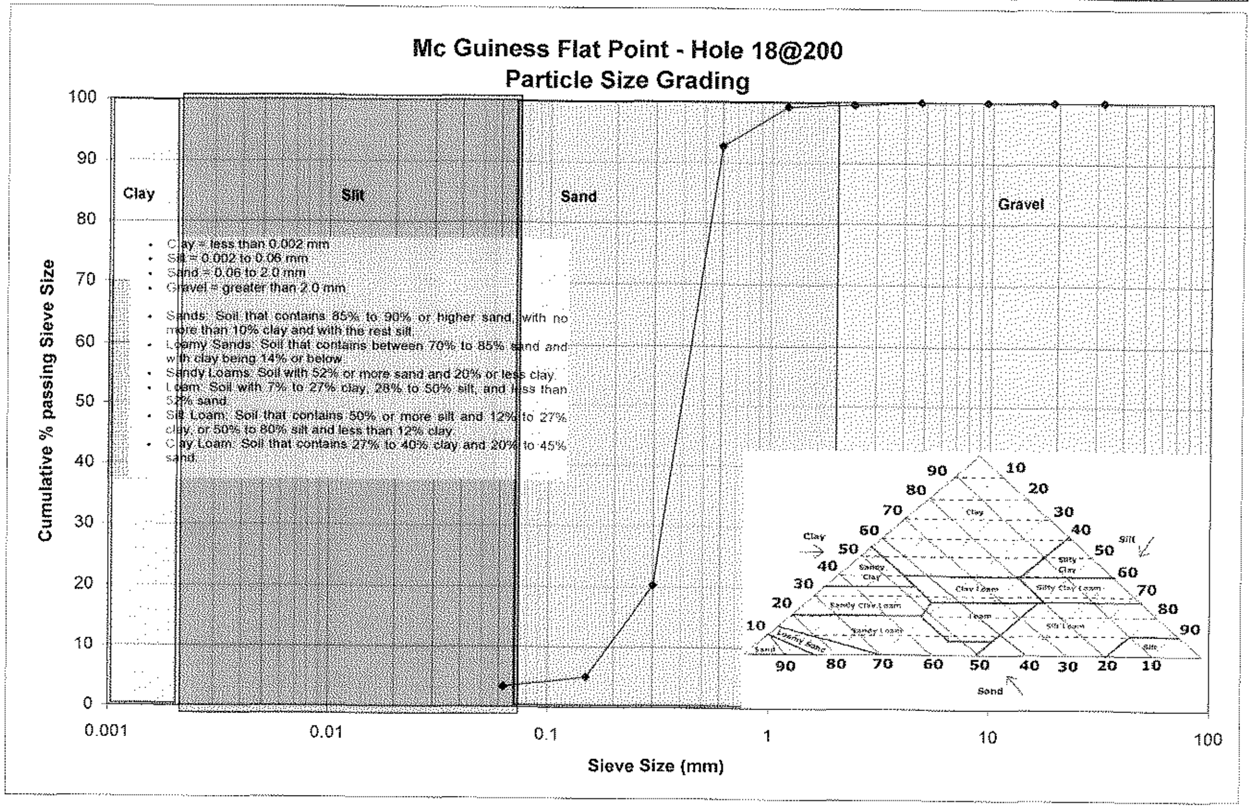


Particle Size Grading Worksheet - Job Number: C99018 Sample: - Hole: 14 @600 Date Sampled: 8/5/2008 Date Analysed: 14/5/2008 Analyst: RV			
Weight of wet sample + container			
Weight of dry sample + container =	986	**Sample Description:**	
Weight of Container =	496	sand	
Weight of dry sample =	490		
Weight of water =			
Moisture Content % =	10.6		
Field capacity as % mc	20.76		
Sieve aperture size	**Cumulative Weight Retained**	**Cumulative Weight Passing**	**Cumulative % passing**
32	0	490	100
19	0	490	100
9.5	0	490	100
4.75	3	487	99.3877551
2.36	4	486	99.18367347
1.18	8	482	98.36734694
0.6	18	472	96.32653061
0.3	390	100	20.40816327
0.15	469	21	4.285714286
0.063	475	15	3.06122449
Total	490	0	0

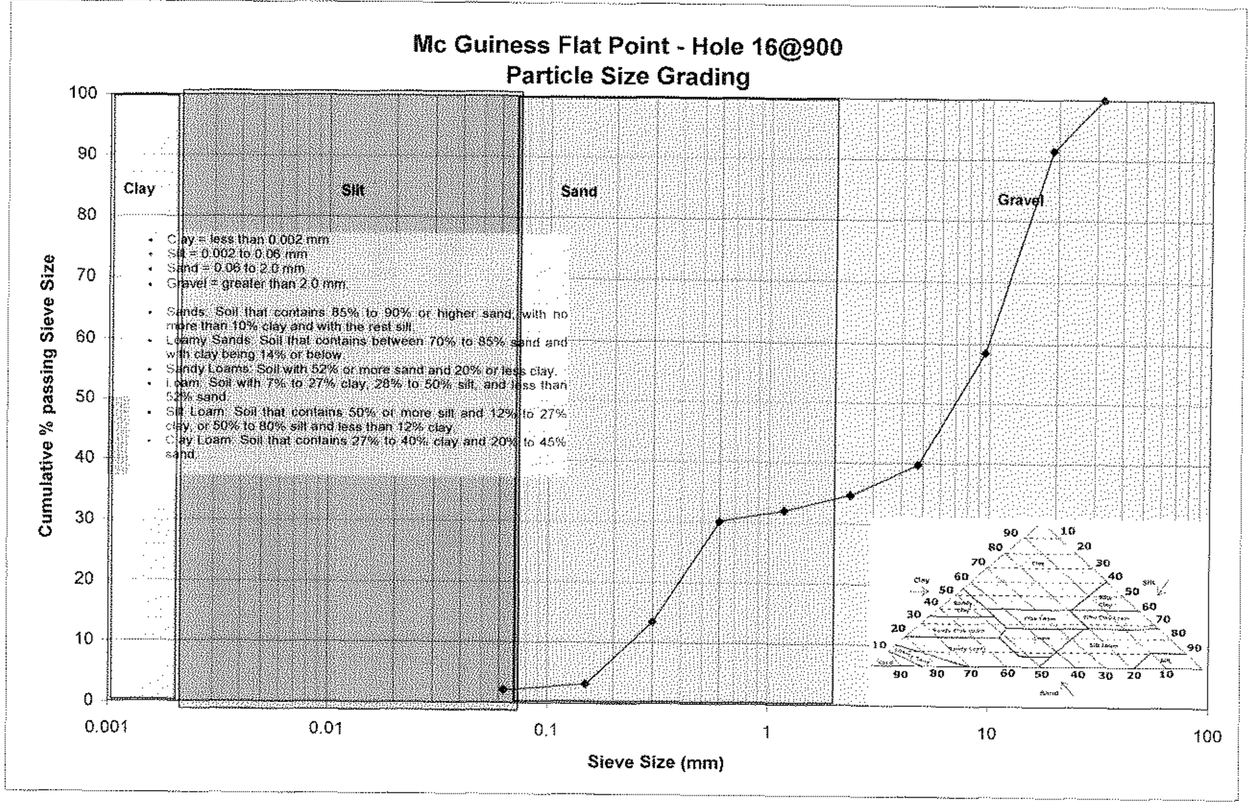


Particle Size Grading Worksheet - Job Number: C99018 Sample: - Hole: 18 @200 Date Sampled: 8/5/2008 Date Analysed: 15/5/2008 Analyst: RV

Weight of wet sample + container			
Weight of dry sample + container =	844	**Sample Description:**	
Weight of Container =	351	sand	
Weight of dry sample =	493		
Weight of water =			
Moisture Content % =	6.62		
Field capacity as % mc	39.76		
Sieve aperture size	Cumulative Weight Retained	Cumulative Weight Passing	Cumulative % passing
32	0	493	100
19	0	493	100
9.5	0	493	100
4.75	0	493	100
2.36	2	491	99.59432049
1.18	4	489	99.18864097
0.6	36	457	92.69776876
0.3	393	100	20.28397566
0.15	468	25	5.070993915
0.063	476	17	3.448275862
Total	493	0	0

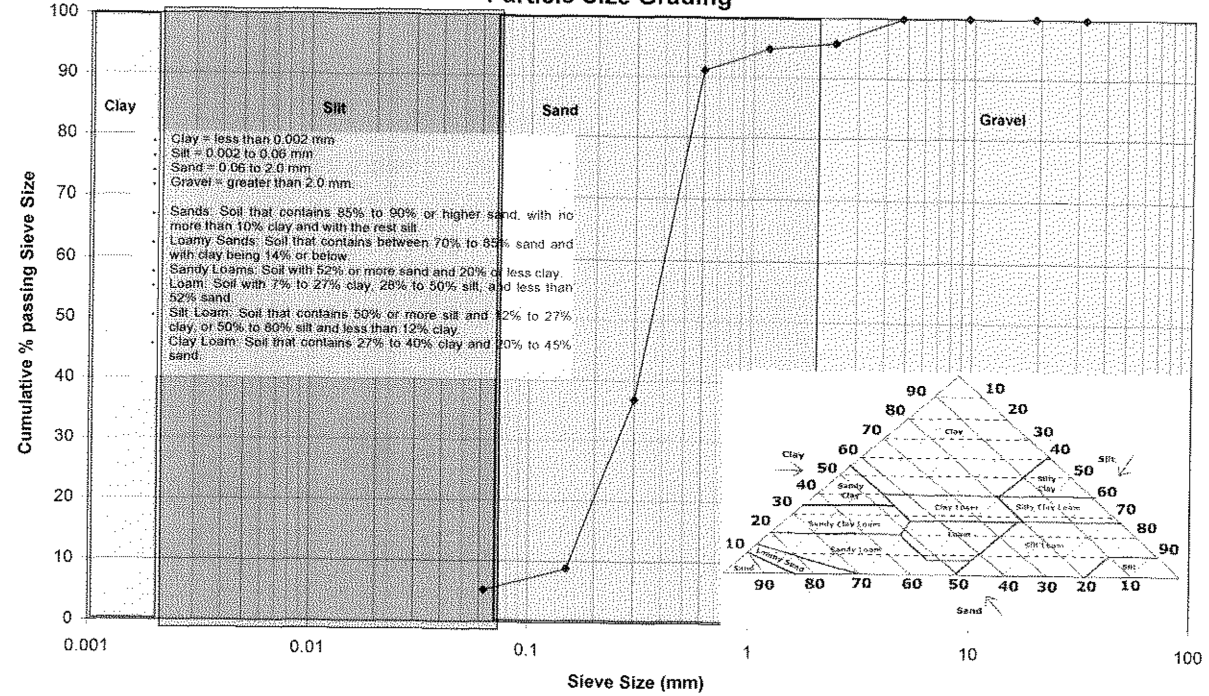


Particle Size Grading Worksheet - Job Number: C99018 Sample: - Hole: 16 @900w Date Sampled: 8/5/2008 Date Analysed: 15/5/2008 Analyst: RV			
Weight of wet sample + container			
Weight of dry sample + container =	694	**Sample Description:**	
Weight of Container =	316	gravel	
Weight of dry sample =	378		
Weight of water =			
Moisture Content % =	17.52		
Field capacity as % mc	23.75		
Sieve aperture size	Cumulative Weight Retained	Cumulative Weight Passing	Cumulative % passing
32	0	378	100
19	32	346	91.53439153
9.5	157	221	58.46560847
4.75	228	150	39.68253968
2.36	247	131	34.65608466
1.18	257	121	32.01058201
0.6	264	114	30.15873016
0.3	327	51	13.49206349
0.15	366	12	3.174603175
0.063	370	8	2.116402116
Total	378	0	0

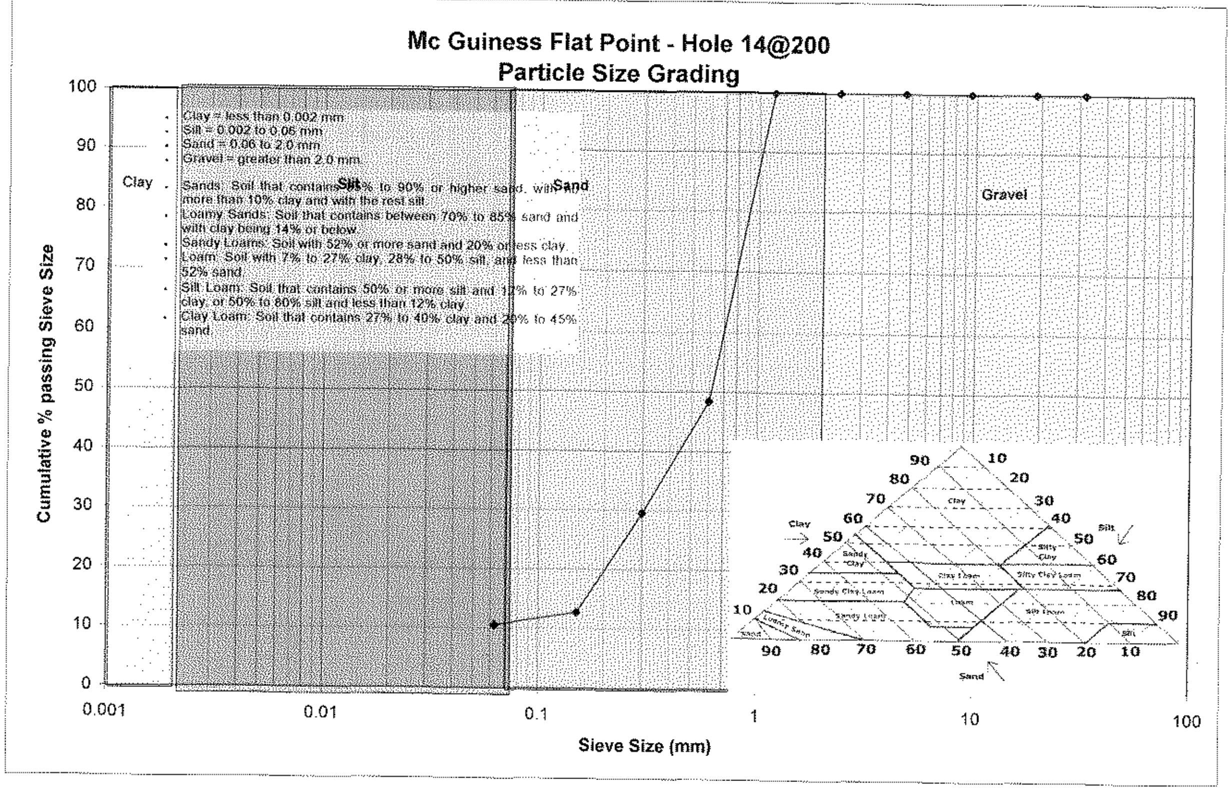


Particle Size Grading Worksheet - Job Number: C99018 Sample: - Hole: 15 @600 Date Sampled: 8/5/2008 Date Analysed: 14/5/2008 Analyst: RV			
Weight of wet sample + container			
Weight of dry sample + container =	846	**Sample Description:**	
Weight of Container =	485	sand	
Weight of dry sample =	361		
Weight of water =			
Moisture Content % =	6.17		
Field capacity as % mc	19.61		
Sieve aperture size	**Cumulative Weight Retained**	**Cumulative Weight Passing**	**Cumulative % passing**
32	0	361	100
19	0	361	100
9.5	0	361	100
4.75	0	361	100
2.36	15	346	95.84487535
1.18	19	342	94.73684211
0.6	32	329	91.13573407
0.3	228	133	36.84210526
0.15	329	32	8.864265928
0.063	342	19	5.263157895
Total	361	0	0

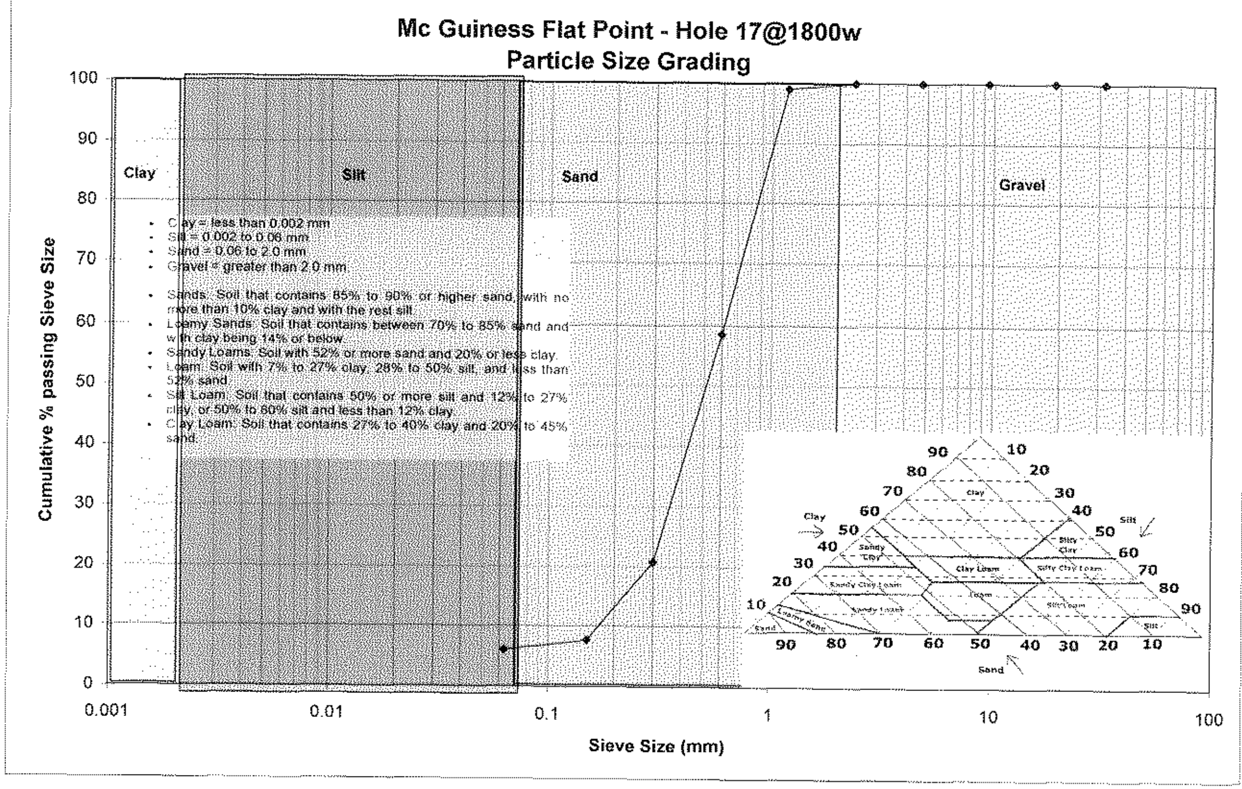
Mc Guiness Flat Point - Hole 15@600
Particle Size Grading



Particle Size Grading Worksheet - Job Number: C99018 Sample: - Hole: 14 @200 Date Sampled: 8/5/2008			
Date Analysed: 14/5/2008 Analyst: RV			
Weight of wet sample + container			
Weight of dry sample + container =	834	Sample Description:	
Weight of Container =	502	Sand	
Weight of dry sample =	332		
Weight of water =			
Moisture Content % =	3.3		
Field capacity as % mc	14.4		
Sieve aperture size	Cumulative Weight Retained	Cumulative Weight Passing	Cumulative % passing
32	0	332	100
19	0	332	100
9.5	0	332	100
4.75	0	332	100
2.36	0	332	100
1.18	0	332	100
0.6	171	161	48.4939759
0.3	234	98	29.51807229
0.15	290	42	12.65060241
0.063	297	35	10.54216867
Total	332	0	0



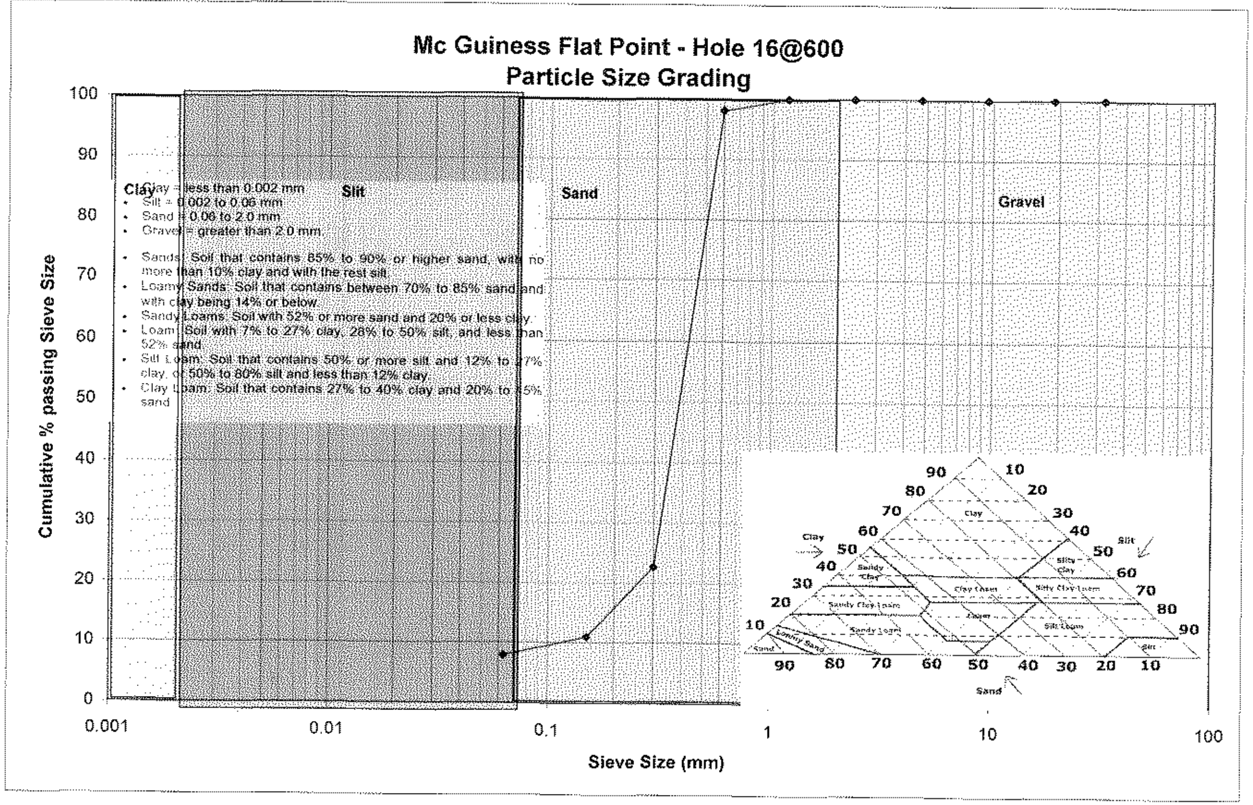
Particle Size Grading Worksheet - Job Number: C99018 Sample: - Hole: 17 @1800w Date Sampled: 8/5/2008 Date Analysed: 15/5/2008 Analyst: RV			
Weight of wet sample + container			
Weight of dry sample + container =	867	**Sample Description:**	
Weight of Container =	488	sand	
Weight of dry sample =	379		
Weight of water =			
Moisture Content % =	15.53		
Field capacity as % mc	19.46		
Sieve aperture size	**Cumulative Weight Retained**	**Cumulative Weight Passing**	**Cumulative % passing**
32	0	379	100
19	0	379	100
9.5	0	379	100
4.75	0	379	100
2.36	0	379	100
1.18	4	375	98.94459103
0.6	157	222	58.57519789
0.3	300	79	20.84432718
0.15	350	29	7.65171504
0.063	356	23	6.068601583
Total	379	0	0



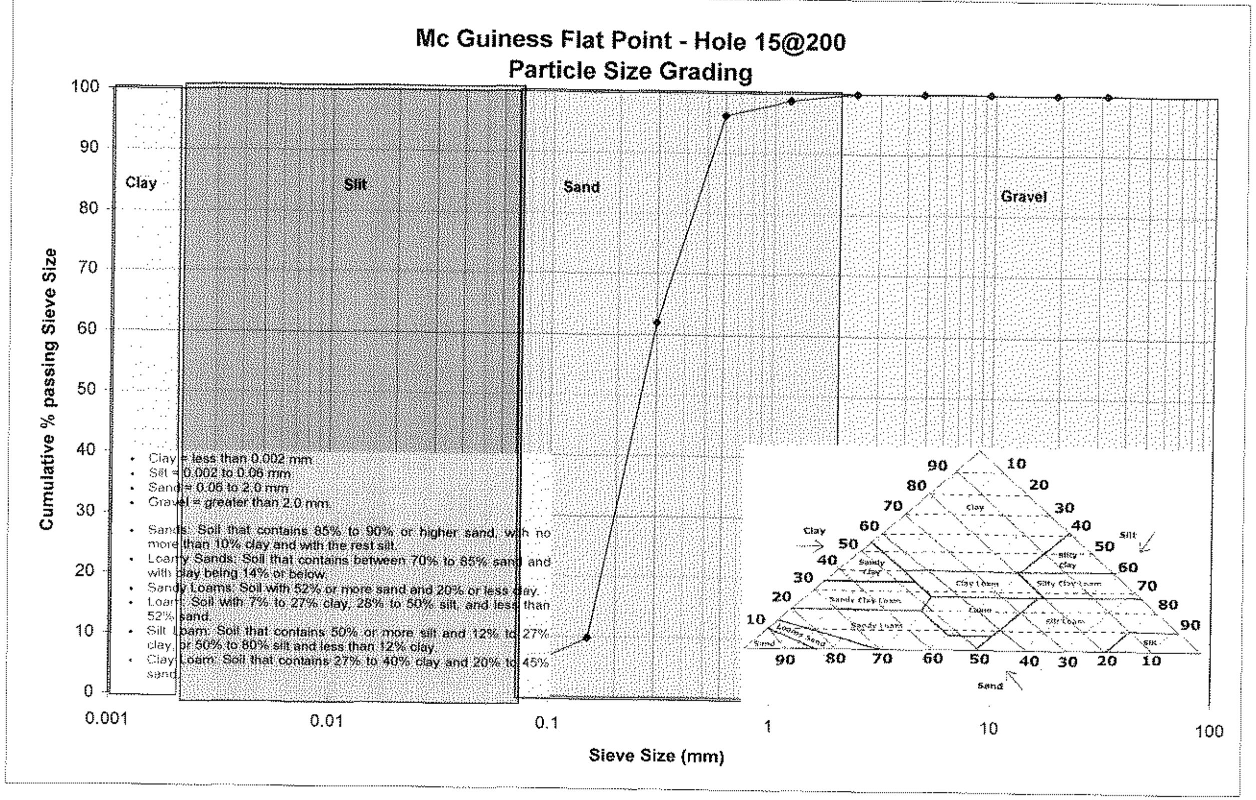
Particle Size Grading Worksheet - Job Number: C99018 Sample: - Hole: 16 @600 Date Sampled: 5/5/2008 Date Analysed: 14/5/2008 Analyst: RV

Weight of wet sample + container			
Weight of dry sample + container =	770	**Sample Description:**	
Weight of Container =	515	sand	
Weight of dry sample =	255		
Weight of water =			
Moisture Content % =	13.2		
Field capacity as % mc			

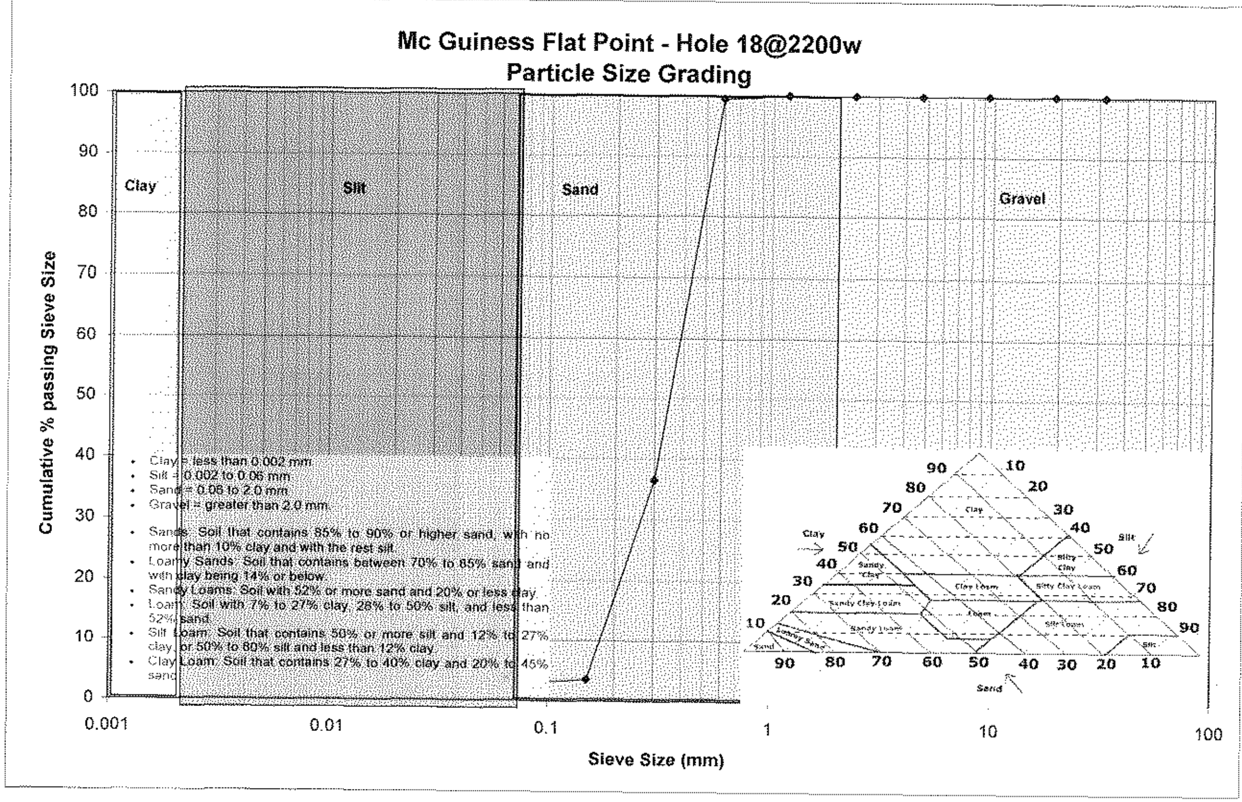
Sieve aperture size	Cumulative Weight Retained	Cumulative Weight Passing	Cumulative % passing
32	0	255	100
19	0	255	100
9.5	0	255	100
4.75	0	255	100
2.36	0	255	100
1.18	0	255	100
0.6	5	250	98.03921569
0.3	197	58	22.74509804
0.15	227	28	10.98039216
0.063	235	20	7.843137255
Total	255	0	0



Particle Size Grading Worksheet - Job Number: C99018 Sample: - Hole: 15 @200 Date Sampled: 8/58/2008 Date Analysed: 14/5/2008 Analyst: RV			
Weight of wet sample + container			
Weight of dry sample + container =	641	**Sample Description:**	
Weight of Container =	478	sand	
Weight of dry sample =	163		
Weight of water =			
Moisture Content % =	6.55		
Field capacity as % mc	20.66		
Sieve aperture size	**Cumulative Weight Retained**	**Cumulative Weight Passing**	**Cumulative % passing**
32	0	163	100
19	0	163	100
9.5	0	163	100
4.75	0	163	100
2.36	0	163	100
1.18	2	161	98.77300613
0.6	6	157	96.3190184
0.3	62	101	61.96319018
0.15	147	16	9.81595092
0.063	158	5	3.067484663
Total	163	0	0

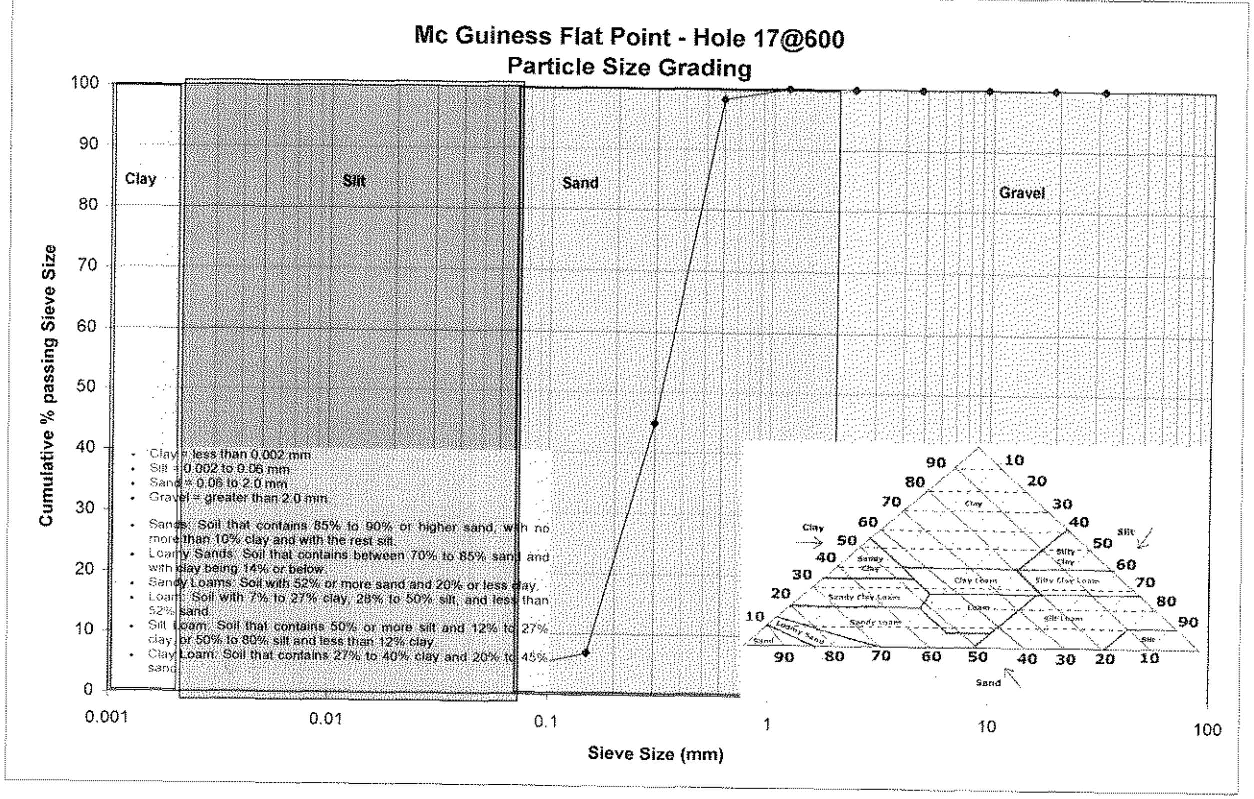


Particle Size Grading Worksheet - Job Number: C99018 Sample: - Hole: 18 @2200w Date Sampled: 8/5/2008 Date Analysed: 14/5/2008 Analyst: RV			
Weight of wet sample + container			
Weight of dry sample + container =	889	**Sample Description:**	
Weight of Container =	494	sand	
Weight of dry sample =	395		
Weight of water =			
Moisture Content % =	13.35		
Field capacity as % mc	14.02		
Sieve aperture size	Cumulative Weight Retained	Cumulative Weight Passing	Cumulative % passing
32	0	395	100
19	0	395	100
9.5	0	395	100
4.75	0	395	100
2.36	0	395	100
1.18	0	395	100
0.6	2	393	99.49367089
0.3	251	144	36.4556962
0.15	381	14	3.544303797
0.063	384	11	2.784810127
Total	395	0	0



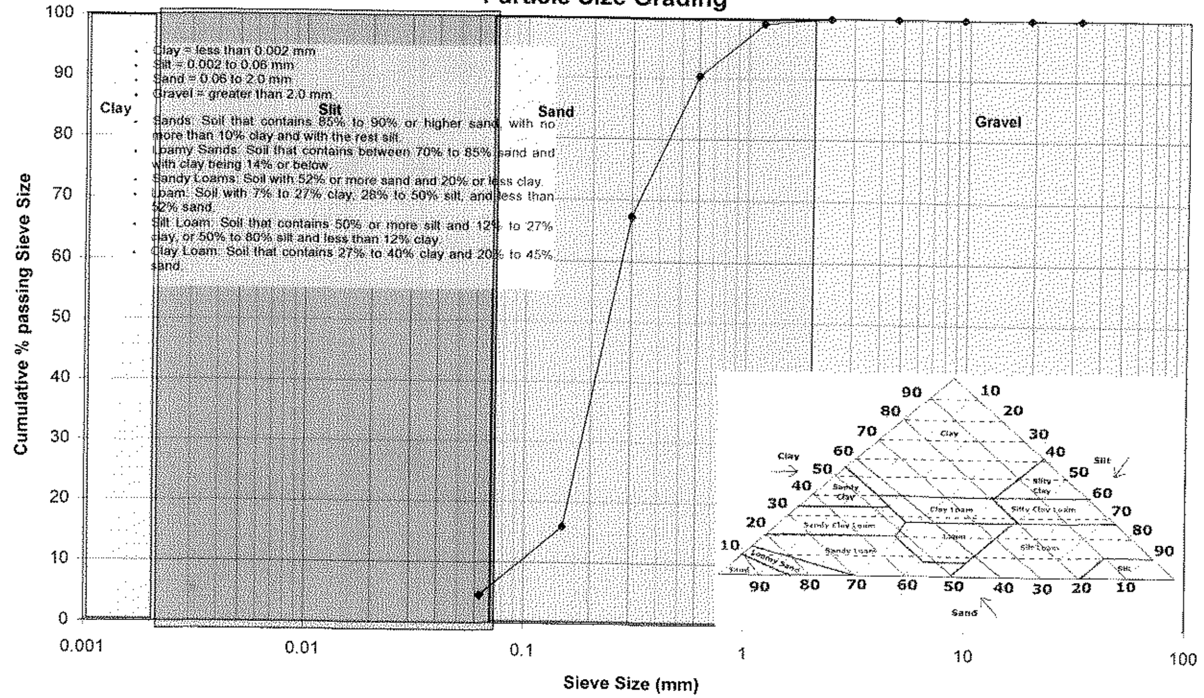
Particle Size Grading Worksheet - Job Number: C99018 Sample: - Hole: 17@600 Date Sampled: 8/5/2008 Date Analysed: 14/5/2008 Analyst: RV

Weight of wet sample + container			
Weight of dry sample + container =	746	**Sample Description:**	
Weight of Container =	514	sand	
Weight of dry sample =	232		
Weight of water =			
Moisture Content % =	4.50		
Field capacity as % mc	15.92		
Sieve aperture size	**Cumulative Weight Retained**	**Cumulative Weight Passing**	**Cumulative % passing**
32	0	232	100
19	0	232	100
9.5	0	232	100
4.75	0	232	100
2.36	0	232	100
1.18	0	232	100
0.6	4	228	98.27586207
0.3	128	104	44.82758621
0.15	216	16	6.896551724
0.063	223	9	3.879310345
Total	232	0	0

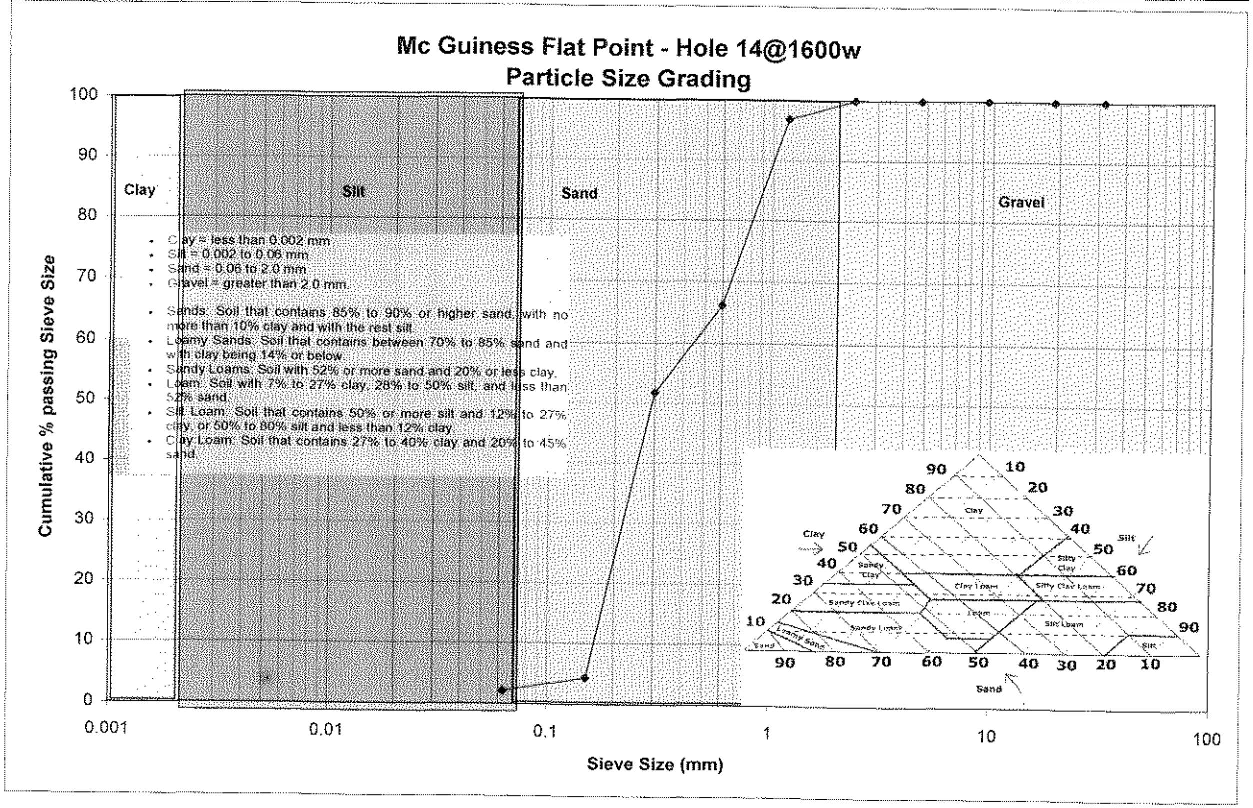


Particle Size Grading Worksheet - Job Number: C99018 Sample: - Hole: 16 @200 Date Sampled: 8/5/2008 Date Analysed: 14/5/2008 Analyst: RV			
Weight of wet sample + container			
Weight of dry sample + container =	590	**Sample Description:**	
Weight of Container =	351	sand	
Weight of dry sample =	239		
Weight of water =			
Moisture Content % =	26.38		
Field capacity as % mc	40.85		
Sieve aperture size	**Cumulative Weight Retained**	**Cumulative Weight Passing**	**Cumulative % passing**
32	0	239	100
19	0	239	100
9.5	0	239	100
4.75	0	239	100
2.36	0	239	100
1.18	2	237	99.16317992
0.6	23	216	90.37656904
0.3	78	161	67.36401674
0.15	201	38	15.89958159
0.063	228	11	4.60251046
Total	239	0	0

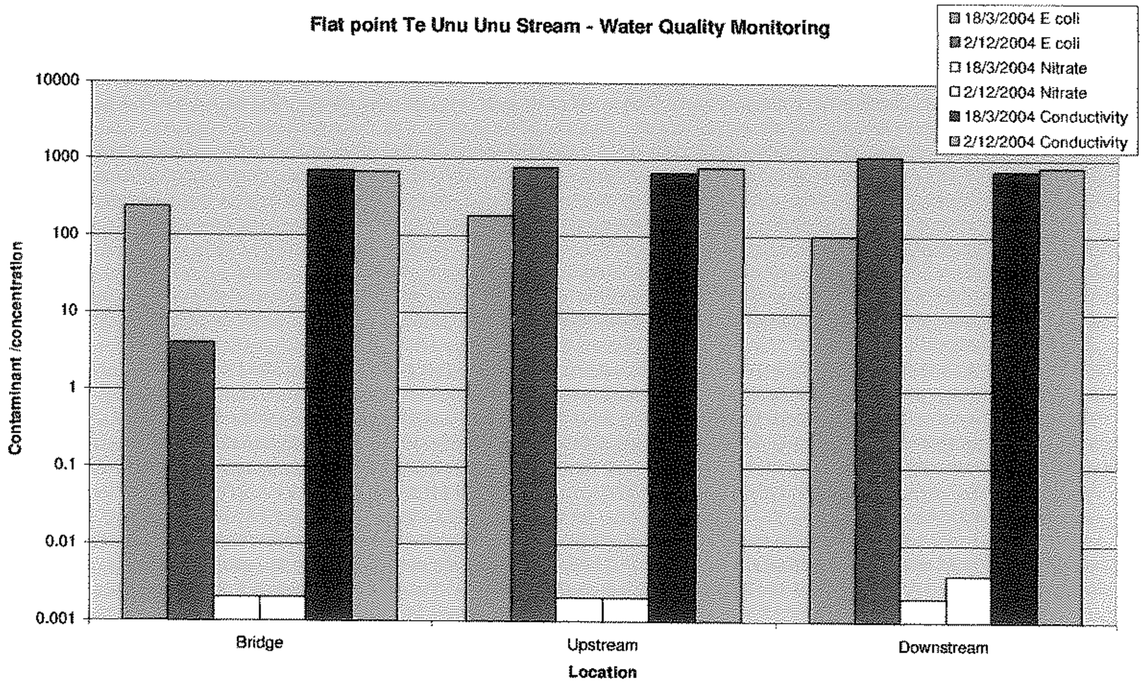
Mc Guiness Flat Point - Hole 16@200
Particle Size Grading

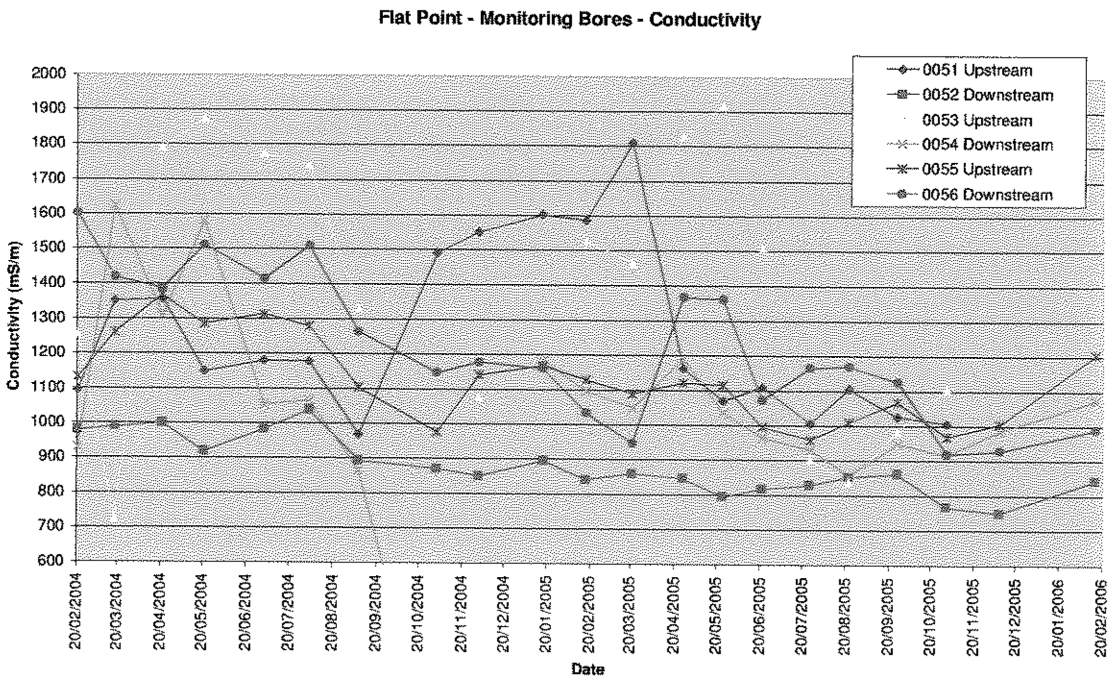


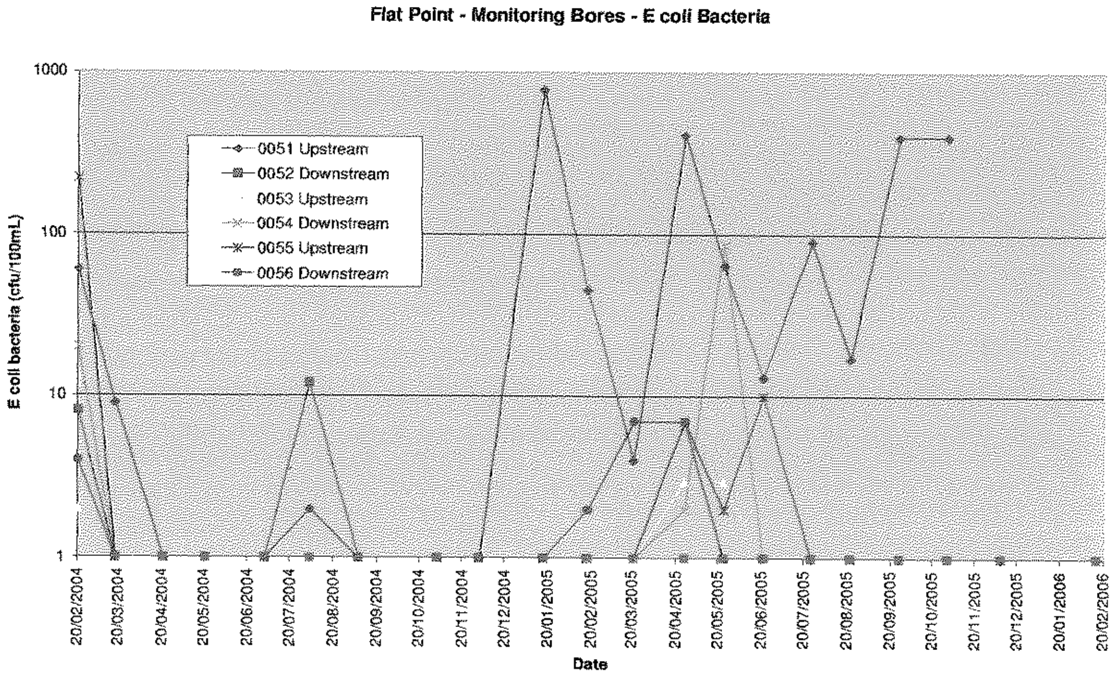
Particle Size Grading Worksheet - Job Number: C99018 Sample: - Hole: 14 @1600w Date Sampled: 8/5/2008 Date Analysed: 15/5/2008 Analyst: RV			
Weight of wet sample + container			
Weight of dry sample + container =	770	**Sample Description:**	
Weight of Container =	353	sand	
Weight of dry sample =	417		
Weight of water =			
Moisture Content % =	14.25		
Field capacity as % mc	15.83		
Sieve aperture size	Cumulative Weight Retained	Cumulative Weight Passing	Cumulative % passing
32	0	417	100
19	0	417	100
9.5	0	417	100
4.75	0	417	100
2.36	0	417	100
1.18	13	404	96.882494
0.6	141	276	66.18705036
0.3	201	216	51.79856115
0.15	399	18	4.316546763
0.063	408	9	2.158273381
Total	417	0	0



Appendix B: Monitoring Results


Flat point Te Unu Unu Stream - Water Quality Monitoring
18/3/2004 E coli
2/12/2004 E coli
18/3/2004 Nitrate
2/12/2004 Nitrate
18/3/2004 Conductivity
2/12/2004 Conductivity
Contaminant /concentration
10000
1000
100
10
1
0.1
0.01
0.001
Bridge
Upstream
Downstream
Location


Flat Point - Monitoring Bores - Conductivity
0051 Upstream
0052 Downstream
0053 Upstream
0054 Downstream
0055 Upstream
0056 Downstream
Conductivity (mS/m)
2000
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
20/02/2004
20/03/2004
20/04/2004
20/05/2004
20/06/2004
20/07/2004
20/08/2004
20/09/2004
20/10/2004
20/11/2004
20/12/2004
20/01/2005
20/02/2005
20/03/2005
20/04/2005
20/05/2005
20/06/2005
20/07/2005
20/08/2005
20/09/2005
20/10/2005
20/11/2005
20/12/2005
20/01/2006
20/02/2006
Date


Flat Point - Monitoring Bores - E coli Bacteria
E coli bacteria (cfu/100mL)
1000
100
10
1
0051 Upstream
0052 Downstream
0053 Upstream
0054 Downstream
0055 Upstream
0056 Downstream
20/02/2004
20/03/2004
20/04/2004
20/05/2004
20/06/2004
20/07/2004
20/08/2004
20/09/2004
20/10/2004
20/11/2004
20/12/2004
20/01/2005
20/02/2005
20/03/2005
20/04/2005
20/05/2005
20/06/2005
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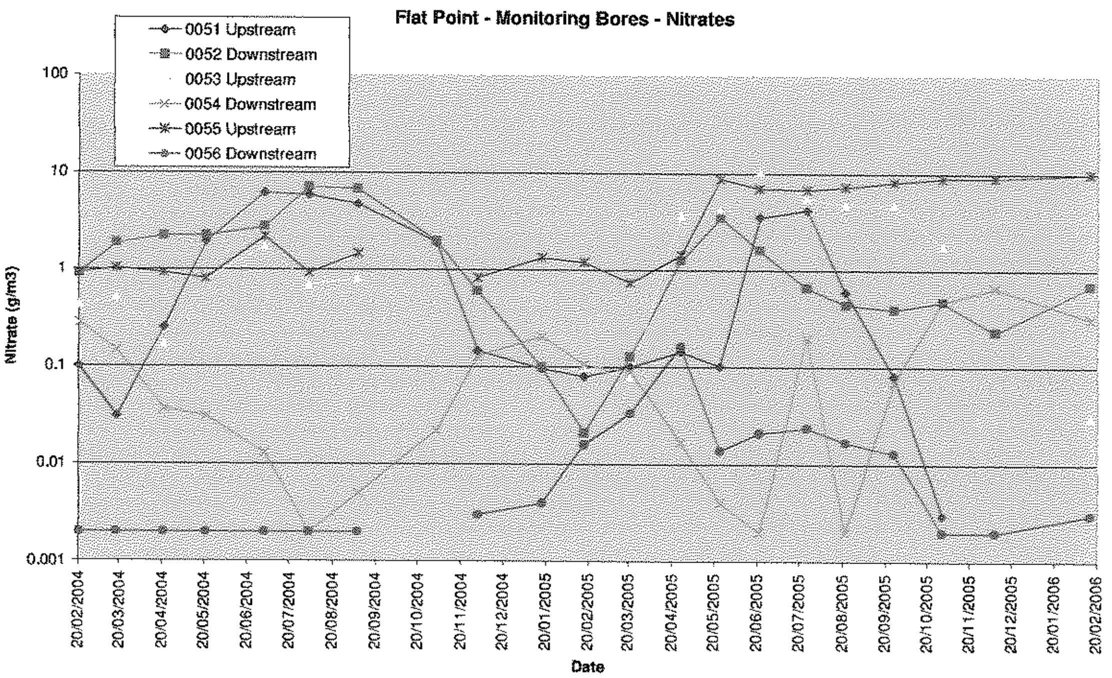
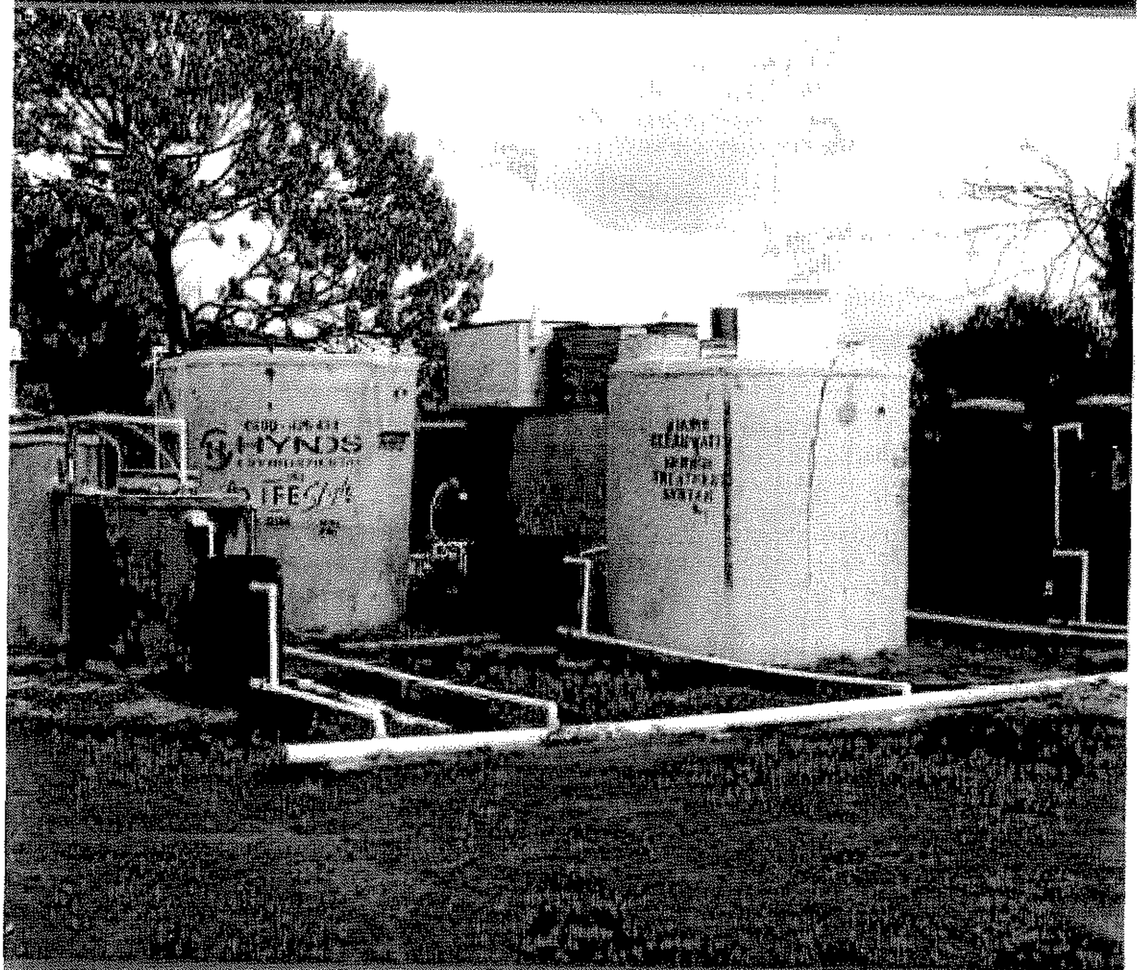
20/10/2005
20/11/2005
20/12/2005
20/01/2006
20/02/2006
Date


Flat Point - Monitoring Bores - Nitrates
Nitrate (g/m3)
100
10
1
0.1
0.01
0.001
0051 Upstream
0052 Downstream
0053 Upstream
0054 Downstream
0055 Upstream
0056 Downstream
20/02/2004
20/03/2004
20/04/2004
20/05/2004
20/06/2004
20/07/2004
20/08/2004
20/09/2004
20/10/2004
20/11/2004
20/12/2004
20/01/2005
20/02/2005
20/03/2005
20/04/2005
20/05/2005
20/06/2005
20/07/2005
20/08/2005
20/09/2005
20/10/2005
20/11/2005
20/12/2005
20/01/2006
20/02/2006
Date

Appendix C: Rotorua Trials Report

Nitrogen reduction trials of advanced on-site effluent treatment systems

Prepared by Paul Scholes, Environmental Scientist



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REGIONAL COUNCIL

Working with our communities for a better environment

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Thanks to all for contributing the time and energy to make this project happen and special thanks to Janine Barber (Environment Bay of Plenty), Andy Bainbridge (Rotorua District Council), suppliers of Advanced On-Site Effluent Treatment Systems, Environment Waikato, Harrison and Grierson.

The combined effort and cooperation of many parties have contributed to this project:

Environment Bay of Plenty: Janine Barber, Paul Futter, Paul Scholes;
Rotorua District Council: Paul Cooper, Andy Bainbridge, Alison Lowe, Sean Barnes, Dave Anderson;
Environment Waikato: Urlwyn Trebilco, Brent Fletcher;

Hynds Environmental: Niki Johnstone;
Devan Blue: Karl Geiseler
Innoflow: Jim Buchan, Keith Martin;
Smith & Loveless: Dan Sharkey;
Oasis Clearwater: Rob White, Lewis Austin;

Executive Summary

Regional Plans from Environment Bay of Plenty and Environment Waikato have recognised the contribution of significant amounts of nutrients (primarily nitrogen) to sensitive receiving environments from communities that rely on on-site effluent treatment systems. Nutrient contributions help to cause the eutrophication of water bodies, especially lakes. As effluent treatment technology has progressed in the past few decades, Regional Authorities are implementing policies that will utilise commercially available on-site effluent treatment technology to avoid adverse effects of nutrient discharges to land degrading water ways.

A trial of five commercially available advanced on-site effluent treatment (OSET) systems has been undertaken to evaluate their potential for nitrogen reduction. Untreated sewage from Rotorua City's Eastside sewer were fed to the advanced OSET systems over 55 weeks with the feed simulating typical domestic use.

Once the systems had stabilised (14 to 16 weeks) all showed the capability to reach Environment Bay of Plenty's On-Site Effluent Treatment Regional Plan 2006 Rule 11 and 13 limit of 15 g/m^3 total nitrogen (TN). Only Innoflow's Orenco AdvanTex® (AX20) system could remain under the 15 g/m^3 TN for a consistent period, achieving 82% TN removal from the influent. Other systems removed on average 63 to 73% TN removal with all systems but one meeting Environment Waikato's Proposed Waikato Regional Plan Variation 5 (Lake Taupo Catchment) discharge limit of 25 g/m^3 TN (see Table 1).

Table 1 *Statistics for Total Nitrogen in effluent and influent for weeks 16 to 55.*

System	Median	Minimum	Maximum
MicroFAST 0.5	23	14	52
Hynds Lifestyle	20	10	29
Oasis 2000	25	10	45
Orenco AdvanTex®	13	7	28
Devan Blue Test System	28	10	53
Devan Blue *DB9000 NRS*	26	10	54
Influent	*71*	*31*	*135*

Monitoring results showed that all systems were able to achieve the biochemical oxygen demand (BOD_5) and suspended solids (SS) discharge limits set in both Environment Bay of Plenty's and Environment Waikato's regional plans. Systems were shown to remove 27-30% of total phosphorus, 92-99% of $CBOD_5$, 96-99% SS, and all systems achieved a better than 10^2 order faecal coliform reduction (Oasis 2000 > 10^5 order).

Installation problems and mechanical failure were some of the reasons attributed to low nitrogen reduction of influent in some systems. External environmental factors were explored as potentially impacting some systems. It was concluded that the as at least two systems achieved excellent TN reduction of the influent that environmental factors had not greatly influenced the trial and were the same for all systems. The functioning of the systems in such things as aeration and solids retention times are not discussed as these parameters were not measured.

Table of Contents

1 Introduction

In the investigations of eutrophication of New Zealand lakes, the contribution of nutrients from on-site effluent treatment (OSET) systems has been implicated as a contributing factor. Due to the location and density of some lake-side communities contributions of up to 25% of the total nitrogen (TN) input to the lake may be coming from OSET systems (NIWA, 2000). To address the continued flow of nutrients into the environment, particularly TN, Environment Bay of Plenty has put in place policies, methods and rules under its On-site Effluent Treatment Regional Plan 2006 (Plan) to limit TN discharges from septic tanks. One method to meet reduction targets set in the Plan is to replace or modify conventional OSET systems with advanced OSET systems.

Nitrogen in influent is primarily composed of organic matter and ammonium-nitrogen, with effluent from conventional OSET systems having greater than 85% ammonium-nitrogen (Bioresearches, 2003). As such, conventional OSET systems have offered little nitrogen treatment. Advanced OSET systems seek to more effectively reduce suspended solids and organic loads as well as reduce nitrogen. Knowledge of the quantity of nitrogen reduction by advanced OSET systems has for the most part relied on information supplied by the manufacturers or suppliers of advanced OSET systems. Bioresearches (2003) documented many of the systems available in New Zealand finding that the TN concentration in the effluent ranged from 0.5 - 45 grams per cubic metre (g/m^3) (i.e. 50 - 80% TN removal)). However, as most of these advanced OSET systems are biological treatment systems employing nitrification-denitrification biological reactions, they are sensitive to a variety of parameters that can affect nitrogen removal efficiencies. For rules for TN discharge limits to be effective, reliable information on the nitrogen reduction from commercially available systems is required.

To gain improved knowledge of the potential for advanced OSET systems to remove nitrogen from domestic influent Rotorua District Council, Environment Bay of Plenty and Environment Waikato commissioned a trial of commercially available advanced OSET systems. A number of manufactures and/or suppliers of OSET systems were approached and as a result five systems were installed for trial (one system, Devan Blue, was changed part way through the trail). All systems were installed without any irrigation treatment connected.

This report details the results of the fifty-five week trial. The primary objective of the trial is to see if TN output from the advanced OSET systems of 15 g/m^3 is achievable, and to discuss factors inhibiting nitrogen reduction. An opportunity is also provided in the trial to observe how well the advanced OSET systems meet suspended solids (SS) and biochemical oxygen demand (BOD_5) levels as set in the On-Site Effluent Treatment Regional Plan 2006.

2 Trial Regime

Five advanced OSET systems (Table 1) were trialed to determine outputs over the period of eleven months (May 2005 to April 2006), with the exception of two systems: Oasis supplied system was monitored for nine months and the original Devan Blue test system was replaced after seven months by the DN9000 NRS (the Devan Blue test system initially installed will not be available on the commercial market)

Untreated wastewater from Rotorua City's Eastside sewer is screened before passing into a header tank from which influent is delivered to the systems in equal quantities. Influent was pumped to each system twice daily by positive displacement pumps operating from a single variable drive. Loading regime was 1.0 m^3/day/system with 66.7% of the load delivered between 6am and 11am every morning and the balance between 6pm and 9pm at night. This pumping regime is designed to simulate average household usage. Harrison Grierson Consultants and AWT NZ Limited provided technical assistance for the trial setup.

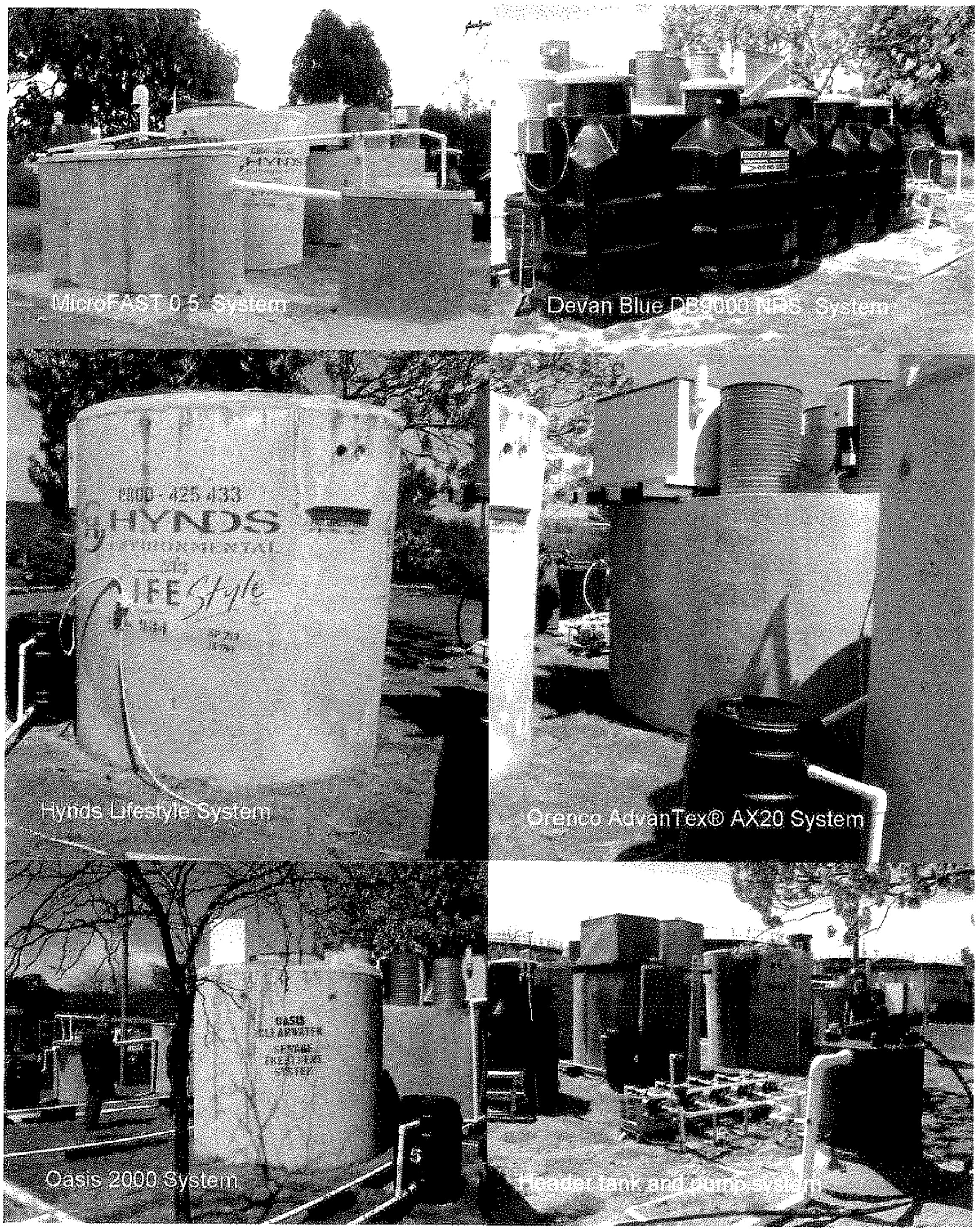

Photo 1 Advanced OSET trial site, Rotorua.

Effluent from each system was collected in a 200 litre drum from which grab samples were taken between 7am and 11am. Sampling occurred every six days. Six days ensured sampling occurred on a different day of the week. Over the fifty-five weeks of sampling, samples were also taken every day for five to six days, every seven to ten weeks. The effluent distribution and sampling programme is based on information from Ewert, Couper and Maginness (2005).

Table 1: System specifications from supplier

Supplier	System	Treatment		Process	Effluent Quality		
		Flow (L/day)	Tank Capacity (L)		BOD_5 (g/m^3)	SS (g/m^3)	TN (g/m^3)
Innoflow Technologies Ltd (Innoflow)	Orenco AdvanTex® (AX20)	1,900	7200	Recirculating textile packed bed filter.	≤ 15	≤ 15	<25#
Hynds Environmental Systems Ltd (Hynds)	Hynds Lifestyle	1,600	8,500 (1,700)^	Submerged Aeration Filtration (SAF) technology.	≤ 20	≤ 20	≤ 25-30
Oasis Clearwater Environmental Systems Ltd (Oasis)	Oasis 2000 (TEXASS)	2,500	9,400	Submerged membrane reactor, aerated waste water system.	≤ 30	≤45	≤10
Smith & Loveless NZ Ltd (FAST)	MicroFAST 0.5	1,800	5,400	Fixed activated sludge treatment, aerated with suspended growth media (with SFR Biomicrobics)	≤ 10	≤ 10	≤ 10*
Devan Blue^Δ (Devan Blue)	DB 9000 NRS	1,500	6,400	Advanced multi stage fixed growth aerated system	≤ 20	≤ 30	-

*Based on total kjeldahl nitrogen (TKN) figures supplied (TKN + Nitrate ≤10).
^ Emergency storage capacity.
# Based on results from Orenco AdvanTex® (AX100) systems (or larger).
Δ Systems specification for new installed system (First system will not be commercially available).

Samples were analysed for pH, alkalinity (Alk), total nitrogen (TN), ammonium-nitrogen (NH_4-N), nitrate-nitrogen (NO_3-N), nitrite-nitrogen (NO_2-N), total phosphorus (TP), dissolved reactive phosphorus (DRP), with the addition analyses of carbonaceous oxygen demand ($CBOD_5$), total suspended solids (SS) and faecal coliforms (FC) over the daily sampling events. Analysis was performed by the Rotorua District Council Environmental Laboratory (IANZ accredited) in accordance with "Standard Methods for the Examination of Waster Water", APHA, AWWA, WPCF. Temperature of effluent was measured in the outflow collection drums. The drums are filled intermittently depending upon the individual system characteristics. As 1,000 litres of influent is introduced to each system over the course of a day, the 200 litre effluent drums are periodically flushed as influent is introduced.

3 Results

The results of analysis are presented in two forms. The first is based on grab samples taken daily over six to seven days, which occurred at four to five week intervals (see Table 2 and Figure 1). The second is based on grab sample data taken every week, where six days equals one week (see Figure 1, Figure 2, and Table 3).

Effluent characteristics of the five systems are variable for most parameters partly due to problems experienced by some systems, changes in influent quality, and environmental factors. All systems do achieve high percentage reductions in SS, $CBOD_5$, FC and TN, once the systems stabilised. After the initial stabilisation period (16 weeks) all systems averaged a better than 90% reduction in $CBOD_5$, SS and FC (Table 3). Reduction in TN varied from 63% to 82% and all systems achieved a very similar reduction in TP, varying from 27% to 30% (Table 3).

The systems generally maintained a pH of greater than pH 7 with the average influent pH at around pH 8. All systems were net users of alkalinity using on average 43% to 81% of alkalinity.

Temperatures increased with the warmer summer months then began to cool again, with the trial ending in autumn. Under normal installation conditions these systems would be inserted in the ground and thus moderated by the insulating effect of the ground. As the systems are above ground it is possible that temperature variations have affected trial results. In winter, it is likely that the advanced OSET systems would go through a greater temperature change over the course of a 24 hour day. The affects of temperature on the systems is further discussed below.

Table 2 Average characteristics of influent and effluent over time.

Influent	Alk (g/m^3)	pH	$CBOD_5$ (g/m^3)	FC cfu/100mls	SS (g/m^3)	Temp °C	NH_4-N (g/m^3)	TKN (g/m^3)	TO_xN (g/m^3)	TN (g/m^3)	TP (g/m^3)
Wk 6/7	273.6	8.4	245	10914286	275	15.8	51.8	72.8	0.2	73.0	12.0
Wk 15/16	224.9	7.7	217	4300000	497	14.7	36.1	53.4	0.0	53.4	9.0
Wk 25/26	210.7	7.7	138	4557143	152	17.9	35.2	50.7	0.0	50.7	7.9
Wk 37/38	279.9	8.2	165	10200000	193	19.5	50.8	67.8	0.3	68.1	10.4
Wk 44/45	322.2	8.3	310	14757143	399	19.8	62.6	91.5	0.0	91.5	13.8
Wk 54/55	286.6	8.3	236	8248333	269	17.8	56.4	75.8	0.0	75.8	11.6
FAST – MicroFAST 0.5											
Wk 6/7	243.1	7.4	52	1765714	27	13.2	42.3	52.4	0.0	52.5	7.8
Wk 15/16	203.9	7.9	7	26617	6	14.5	32.1	35.7	2.0	37.7	8.7
Wk 25/26	161.4	7.6	12	85714	15	18.0	17.8	22.2	2.8	24.9	9.1
Wk 37/38	161.0	7.7	7	70833	6	20.8	19.1	23.8	2.2	26.0	9.0
Wk 44/45	176.0	7.8	9	134000	9	19.0	22.7	26.9	1.9	28.8	8.9
Wk 54/55	91.0	7.3	5	57083	6	16.2	5.9	8.4	5.9	14.2	8.0
Hynds Lifestyle											
Wk 6/7	14.4	6.4	7	279143	13	12.5	1.2	4.7	35.9	40.6	6.9
Wk 15/16	51.3	7.2	2	20367	3	12.8	0.2	2.5	19.2	21.7	8.2
Wk 25/26	69.0	7.2	5	42429	5	17.2	0.2	3.2	12.5	15.7	8.7
Wk 37/38	52.6	7.2	4	26000	7	19.9	0.5	3.5	17.8	21.3	8.7
Wk 44/45	32.0	7.0	4	9461	9	18.3	0.3	2.6	22.2	24.8	8.2
Wk 54/55	62.1	7.4	1	15683	2	16.3	0.1	1.6	9.9	11.5	8.1
Oasis – Oasis 2000											
Wk 6/7	-	-	-	-	-	-	-	-	-	-	-
Wk 15/16	78.1	7.4	8	83133	6	13.1	10.9	15.4	29.1	44.4	7.5
Wk 25/26	33.3	7.2	1	7	1	18.1	0.1	1.4	24.0	25.4	8.2
Wk 37/38	67.7	7.3	5	148	10	20.0	0.6	2.6	18.2	20.9	9.1
Wk 44/45	294.1	8.3	2	12	3	16.7	32.6	34.7	0.6	35.3	5.7
Wk 54/55	59.6	7.4	1	3	0	15.9	0.0	0.4	14.8	15.2	7.3
Innoflow - Orenco AX20®											
Wk 6/7	152.6	7.2	5	12729	8	11.8	21.5	23.8	11.0	34.8	7.3
Wk 15/16	61.1	6.6	3	53967	5	12.4	0.4	3.2	19.4	22.6	7.8
Wk 25/26	71.3	6.9	2	37314	2	17.1	0.1	1.9	12.5	14.4	8.6
Wk 37/38	70.5	6.7	1	44286	2	19.6	0.2	1.5	13.3	14.8	8.3
Wk 44/45	82.8	7.1	1	51857	2	17.6	0.2	1.4	9.3	10.8	8.1
Wk 54/55	72.0	6.8	1	24467	1	15.7	0.1	0.8	9.7	10.5	7.5
Devan Blue – DB9000 NRS (& Test System)											
Wk 6/7	184.8	7.7	20	1228000	16	12.9	31.2	35.1	2.6	37.7	7.7
Wk 15/16	206.4	7.6	10	62167	8	14.6	33.7	37.7	1.7	39.5	8.5
Wk 25/26	120.7	7.4	6	16629	5	18.3	16.2	18.9	6.9	25.8	8.6
Wk 37/38	*49.9*	*7.1*	*8*	*16229*	*10*	*19.7*	*6.4*	*10.4*	*17.1*	*27.5*	*8.7*
Wk 44/45	*206.9*	*7.2*	*84*	*422857*	*11*	*17.6*	*32.0*	*38.1*	*0.0*	*38.1*	*8.4*
Wk 54/55	*89.9*	*7.3*	*5*	*20167*	*6*	*16.3*	*9.6*	*8.6*	*3.5*	*12.1*	*8.3*

Note: Figures in italics show the results for the second installed Devan Blue system.

Table 3 Percentage removal of influent constituents by OSET systems.

System	TN	TP	$CBOD_5$	SS
MicroFAST 0.5	67%	30%	96%	96%
Hynds Lifestyle	73%	31%	98%	98%
Oasis 2000	63%	27%	99%	98%
Orenco AX20®	82%	30%	99%	99%
Devan Blue DB9000 NRS	63%	30%	84%	87%

Figure 1 shows a plot of TN over the 55 week trial. In Figure 1 and Figure 2 it can be seen that Orenco AdvanTex® (AX20) and Hynds Lifestyle systems have achieved the best nitrogen reduction, followed by the MicroFAST 0.5. The range of TN found in the effluent and influent as well as medium and inter-quartile data is displayed in Figure 2. Data used to derive Table 4 and Figure 2 is from week 16 onwards, after which time the systems had stabilised and good TN removal rates were occurring for most systems.

Table 4 Statistics for Total Nitrogen for weeks 16 to 55.

System	n	Mean (g/m^3)	Median (g/m^3)	Minimum (g/m^3)	Maximum (g/m^3)	Std.Dev. (g/m^3)
MicroFAST 0.5	42	25	23	14	52	8
Hynds Lifestyle	42	20	20	10	29	4
Oasis 2000	33	27	25	10	45	8
Orenco AX20®	42	14	13	7	28	4
Devan Blue Test	24	33	28	13	53	12
Devan Blue DB9000 NRS*	16	27	26	10	54	13
Influent	*42*	*71*	*71*	*31*	*135*	*28*

* Statistics representing the new Devan Blue installation from week 41 to 55.

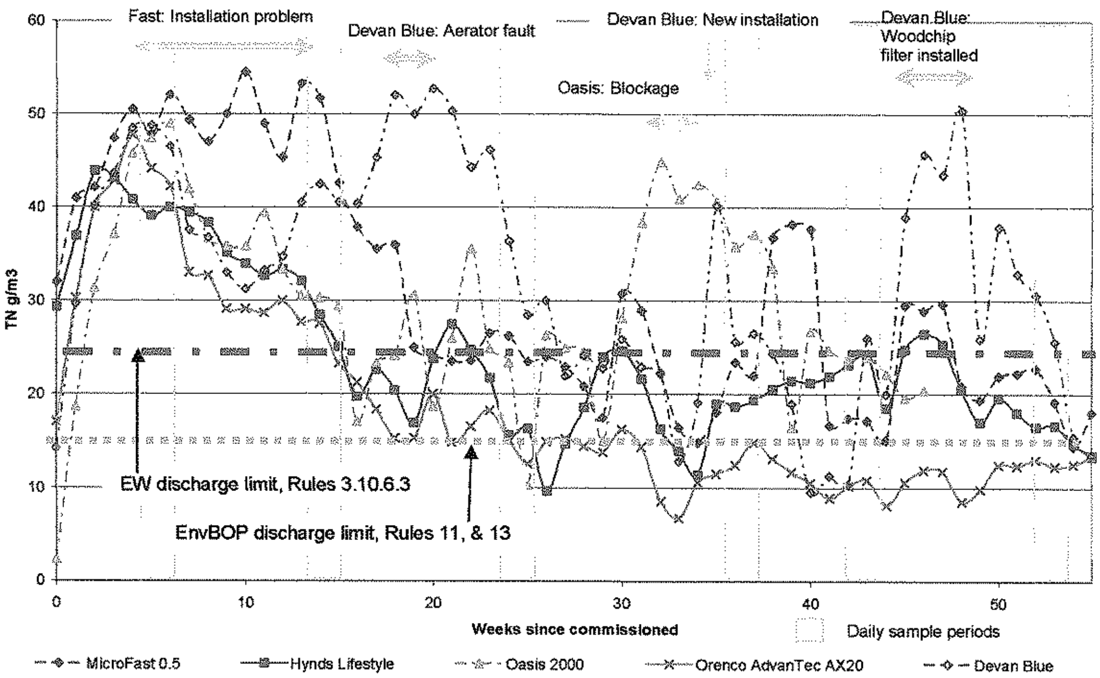

Figure 1: Total Nitrogen for five advanced on-site effluent treatment systems.

All systems did achieve less than 15 g/m^3 TN in effluent at some stage in the trial. However, only one system did this with any consistency. Other systems dipped below the 15 g/m^3 TN target for only a short period.

Systems have taken around 14 to 16 weeks to settle in as nitrifying bacteria numbers build up and nitrification-denitrification process starts to function effectively (Figure 1). After this time all systems (apart from the MicroFAST 0.5 system) start markedly reducing the total nitrogen in their outflow. The Devan Blue supplied test system seems to be on par with the Innoflow and Hynds supplied systems until week 10 when the TN content of the raw sewage increased. After this point the Devan Blue supplied test system has an increased TN concentration in its output and shows some recovery when the TN concentration of the raw sewage drops.

An incorrect installation has been found to be the reason for the MicroFAST 0.5 systems lack of performance in nitrogen reduction over the first 14 weeks of the trial. This problem was rectified on 22 July (week 14) and adjustments made through to the 29 July.

A blockage and consequent overflow from the Oasis 2000 system has also affected nitrogen renovation over weeks 30 to 34. It would also appear that further problems have occurred with the MicroFAST 0.5 and Devan Blue systems at various times from week 34 onwards (Figure 1). A new Devan Blue system was installed at week 36. The new system stabilised relatively quickly under summer conditions achieving under 15 g N/m^3 TN. However, it would seem installation of a wood chip filter has detrimentally impacted on the system impeding nitrification.

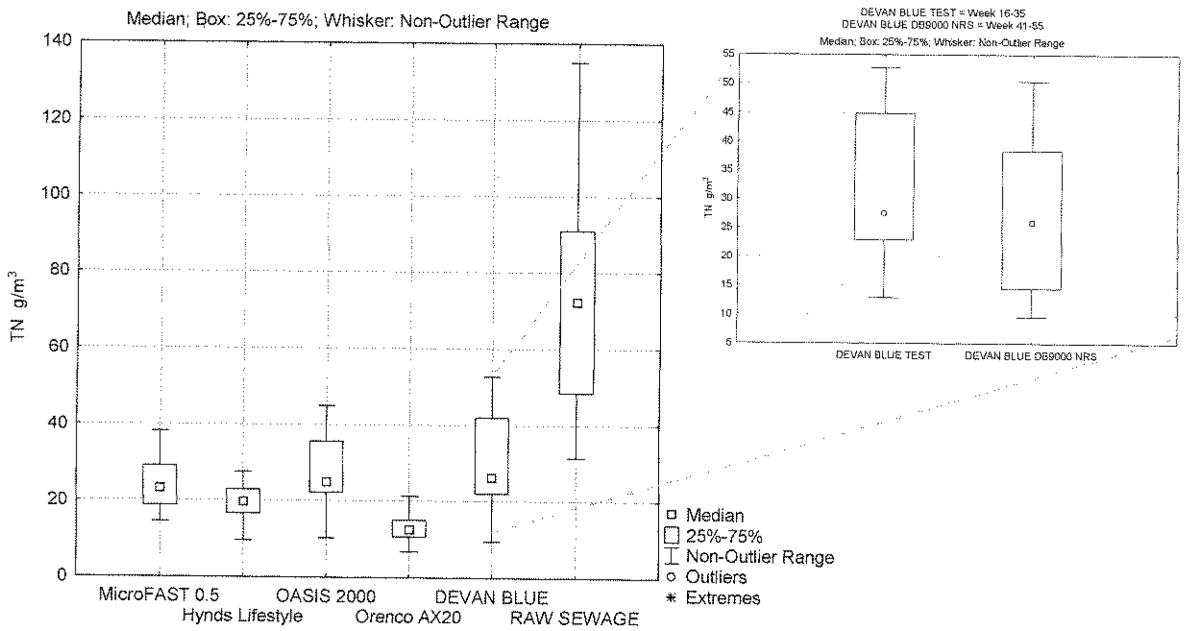

Figure 2: Total nitrogen box-whisker plots for advanced on-site effluent treatment system effluent and influent, from week 16 (Oasis 2000 from week 26). Insert shown box-whisker plots for the 2 systems Devan Blue ran over the 55 week trial period.

Faecal coliform levels were generally reduced by an order of greater than 10^2 (Figure 3). The Oasis 2000's membrane filtration system achieved the best faecal coliform reduction being greater on average than 10^5 reduced.

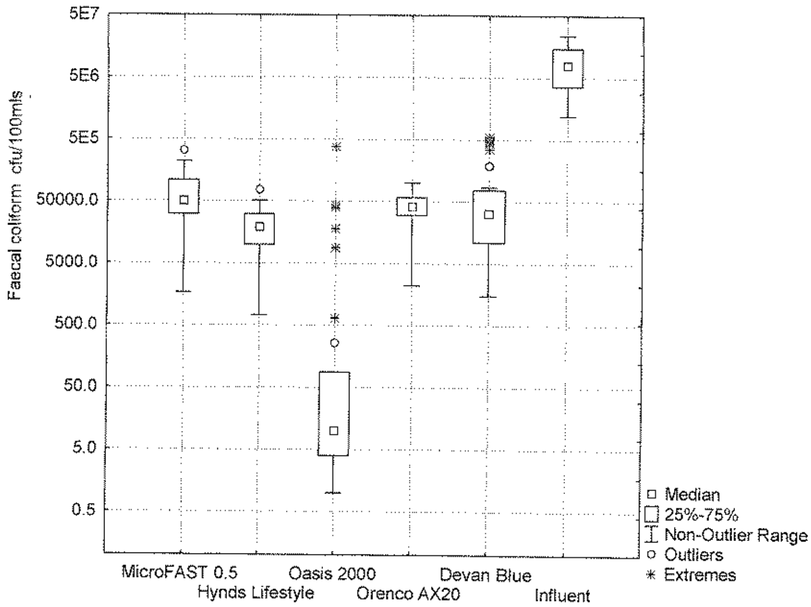

Figure 3 Faecal coliform box-whisker plots for advanced on-site effluent treatment system effluent and influent, from week 15.

4 Discussion

The Innoflow supplied system (Orenco AdvanTex® AX20) achieved a median TN of 13 g/m^3 for the period week 16 to 55, with TN removal efficiency better than 88% at its peak performance (Figure 4). This was the only system to consistently remain under the 15 g N/m^3 target. Next best was the Hynds system, with a median of 20 g/m^3 TN and a peak removal of over 84% TN. Median values for MicroFAST 0.5 and Oasis 2000 systems (23 and 25 g/m^3 respectively) meet Environment Waikato's permitted activity rule discharge limit of 25 g N/m^3 in the effluent. The Devan Blue systems median TN value over the 41 to 55 week period was just above the 25 g N/m^3 limit, at 26 g N/m^3 for the DB9000 NRS system.

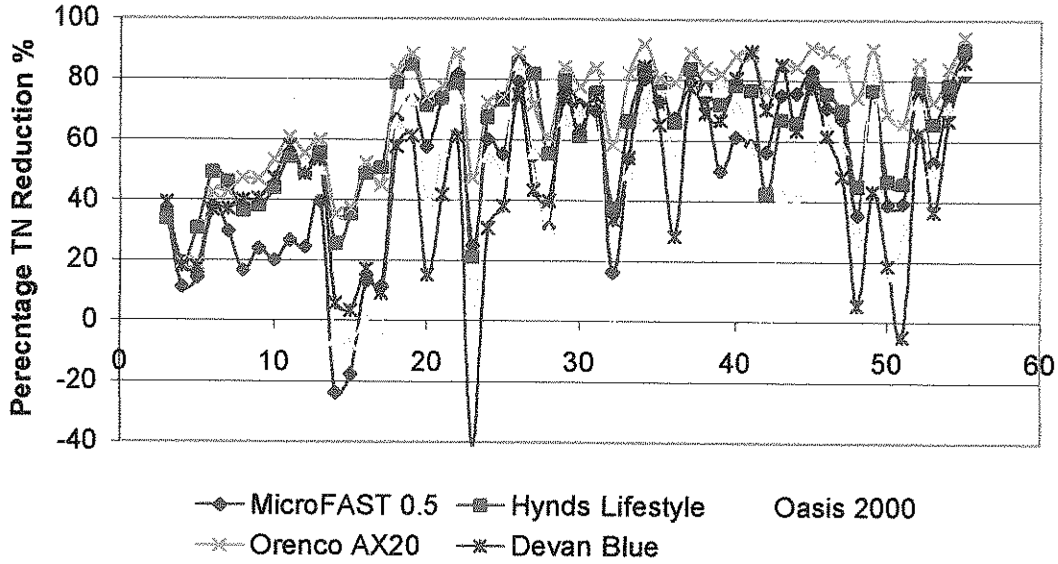

Figure 4 Percentage TN removal or influent by advanced on-site effluent treatment systems, based on data weekly data.

Both the Innoflow and Hynds supplied systems have been effective in nitrification and nitrate dissimilation. The other systems have at time had problems with nitrification. This can be partly explained by mechanical faults and installation problems, but there are other factors that have been raised as potential reasons for less than ideal total nitrogen reduction.

Reduction of TN through nitrification-denitrification and nitrate dissimilation in septic systems can be affected by a variety of factors. These include:

- features of the systems (e.g. capacity, surface area, circulation, etc.);
- dissolved oxygen content;
- organic loading rate and solids retention time;
- inhibiting substances;
- alkalinity and pH;
- available carbonaceous material; and
- temperature.

4.1 System Features and Function

Each system has different features and this analysis will not dwell on any specific system feature(s) or function(s), accept to report electricity consumption (measured during the trial).

Two systems had consistent electricity consumption over the trial period (Figure 5), Orenco AdvanTex® and Hynds Lifestyle. Other systems had variable consumption due to a variety of factors: mechanical failure; incorrect installation; and blockages.

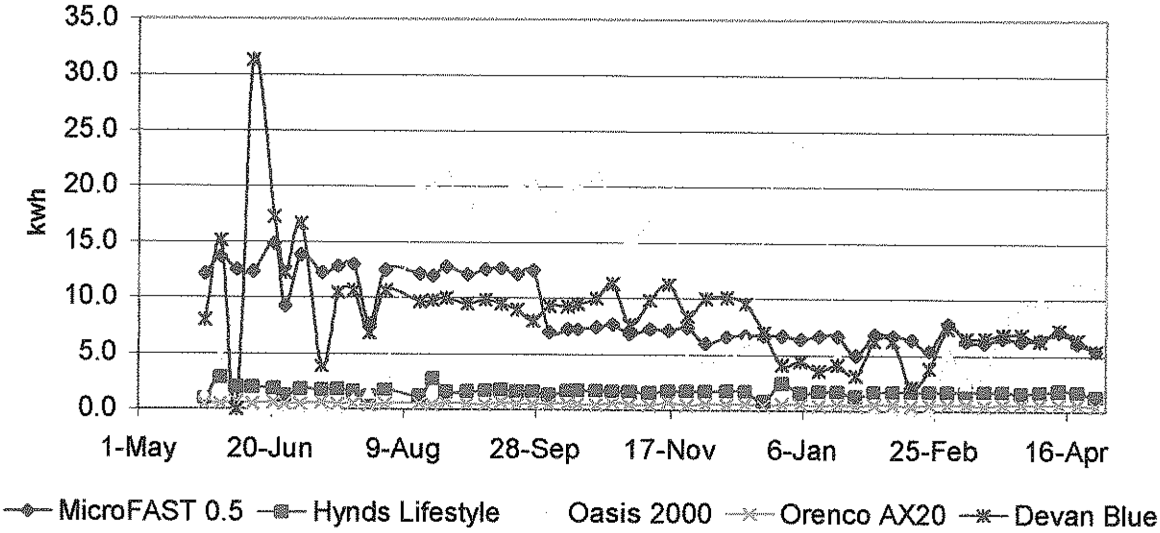

Figure 5 Electricity consumption by advanced OSET systems over trial.

4.2 Dissolved Oxygen

Specific system aeration characteristic and dissolved oxygen (DO) content are not being measured in this study and so cannot be considered in this analysis. It is just worth mentioning that decreased DO can become a growth limiting factor in the nitrification process, and this is likely to have played a part in the increase in TN in the Devan Blue test system when the aerator malfunctioned.

4.3 Organic Loading Rate and Solids Retention Times

Organic loading rate and solids retention times can affect both nitrification and denitrification. The loading rate (influent) is fixed for all systems and is designed to be representative of the loading rate for an average household within the design specification of the systems. However, depending upon how an effluent treatment system is designed the ratio of BOD_5 to total kjeldahl nitrogen (TKN) can affect the nitrification process.

Figure 6 shows the correlation between $CBOD_5$ and TKN in the influent over the trial. This correlation plot shows that over the trial the ratio between $CBOD_5$ and TKN has been reasonably consistent. Using a conversion factor for changing $CBOD_5$ to BOD_5 of 0.68 the median ratio of BOD_5:TKN is 2.0 (sd = 0.7). Such a ratio suits systems with a separate stage nitrification chamber (Water Pollution Control Federation, 1983). Most systems have such a chamber and this helps increase the BOD_5:TKN for nitrification in the next stage. Thus the organic content of the influent should be suitable for most advanced on-site effluent treatment systems trialled, with the influent being delivered at a fairly consistent BOD_5:TKN ratio.

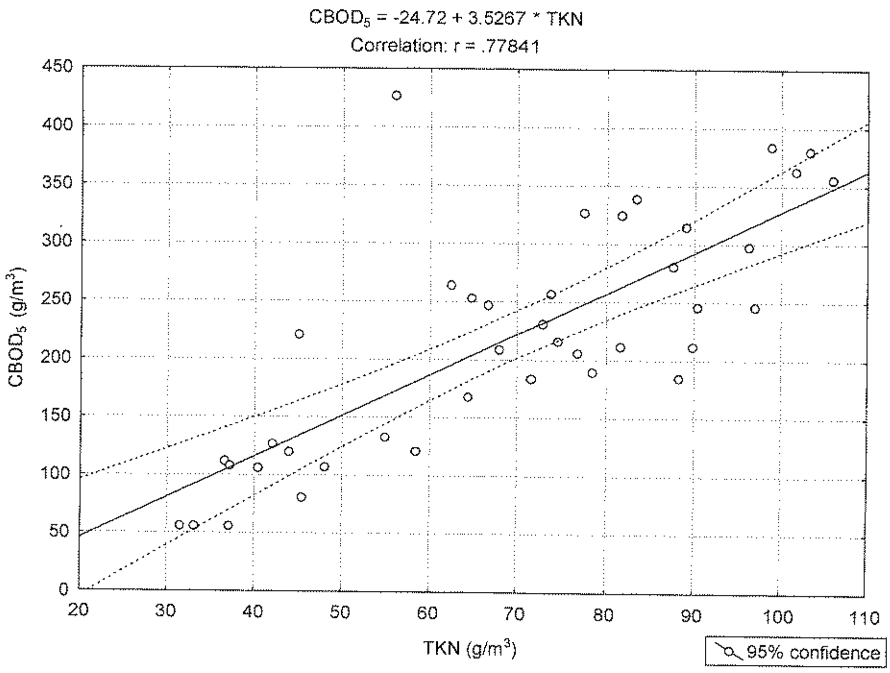

Figure 6 Correlation of $CBOD_5$ and TKN in influent

4.4 Inhibiting Substances

The influent comes from a predominantly urban source, with minimal contributions from industrial and commercial premises. It is likely that a variety of substances could be present in the sewage that may affect the growth of bacterial species and enzymes in the advanced OSET systems. However, inhibition of nitrification does not seem to have occurred in the Orenco AdvanTex® and Hynds Lifestyle systems, with both systems achieving high ammonium-nitrogen conversion to nitrate and nitrite. Thus it is likely that the influent has not contained inhibiting substances in high enough concentrations to greatly impact on the nitrification process in the advanced OSET systems.

4.5 Alkalinity and pH

A low pH will inhibit nitrification/denitrification and this is controlled by the available alkalinity. The pH in all systems remains fairly stable (Table 2), however the Orenco AdvanTex® and Hynds Lifestyle outflow pH is as low as 6.2 due to reduced alkalinity (Alk < 50 g/m^3). Generally an alkalinity of greater than 50 g/m^3 is recommended to deal with fluctuations in influent ammonium-nitrogen concentrations. For pH the recommended optimum level for nitrification is a pH of 7.5 to 8.6, while maintaining a pH of greater than 7.2, and between 7 and 8 for denitrification (Water Pollution Control Federation, 1983). In both the Innoflow and Hynds, systems once the pH drops below 7 pH units, nitrite concentrations are reduced and TN reduction can be affected. However, in weeks 54/55 the pH in the Orenco AdvanTex® system drops below pH 7 and with alkalinity above 50 g/m^3 excellent nitrogen reduction is still achieved.

4.6 Carbon Content

Removal of available carbon in the advanced on-site effluent treatment systems occurs in settling, nitrification, and dissimilation of nitrate. An excess of available carbon in the nitrification process can limit nitrifying bacterial growth. The microorganisms responsible for completing the dissimilation of nitrate are facultative heterotrophic aerobes contained in the wastewater that are also responsible for $CBOD_5$ oxidation. While some systems are obtaining low $CBOD_5$ results (Figure 6) they may also be running low on organic carbon and so do not have enough carbonaceous material to be used as an energy source and an electron donor. As such systems with low carbon content may be limited in further TN reductions, dependant upon their set-up.

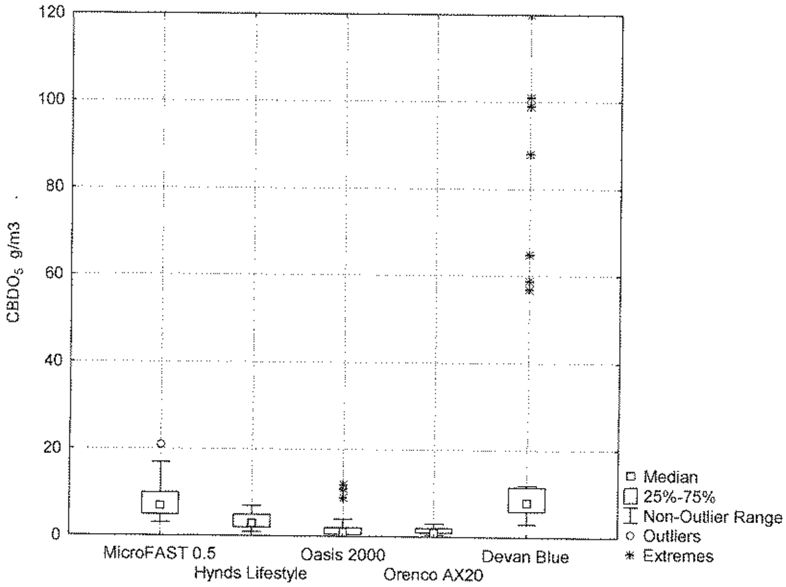

Figure 7 CBOD$_5$ box-whisker plots for advanced on-site effluent treatment system outflows, from week 15.

4.7 Temperature

Temperature effects the biochemical reactions within the advanced on-site effluent treatment system. Changes in the influent can also be brought about by seasonal temperature differences. Temperature changes (diurnal or otherwise) within the systems are difficult to establish without 24 hour monitoring, but is likely to vary within in each chamber. Figure 8 shows that the effluent temperatures have their greatest difference between readings in winter, lying somewhere between influent and ambient air temperatures. Effluent temperatures reach just under 10°C in winter and over 20°C in summer.

Comparison of ambient air temperatures (measured at Pererika, Rotorua) with effluent temperatures indicate that effluent temperature in the systems drops with air temperature changes. It is unlikely that the extent of diurnal variation temperature that occurs in ambient air is repeated in the systems, as the lowest temperature recorded in the 200L drums was 8.5 °C compared to an 8am low of 4.0 °C. This would suggest that heat loss occurs, but may not be significant in the systems over a 24 hour period.

As temperature effects nitrification it also has a direct relationship with the growth of microorganisms. The rate of ammonium-nitrogen oxidation is directly proportional to growth of nitrifying organisms and it can be seen that in both the Innoflow and Hynds systems ammonium-nitrogen oxidation has been achieved almost completely regardless of temperature variation. Effluent from the Orenco AX20® has recorded the lowest temperatures (Figure 8) and yet has one of the best nitrification rates, also suggesting temperature has not had much of an impact on the TN reduction.

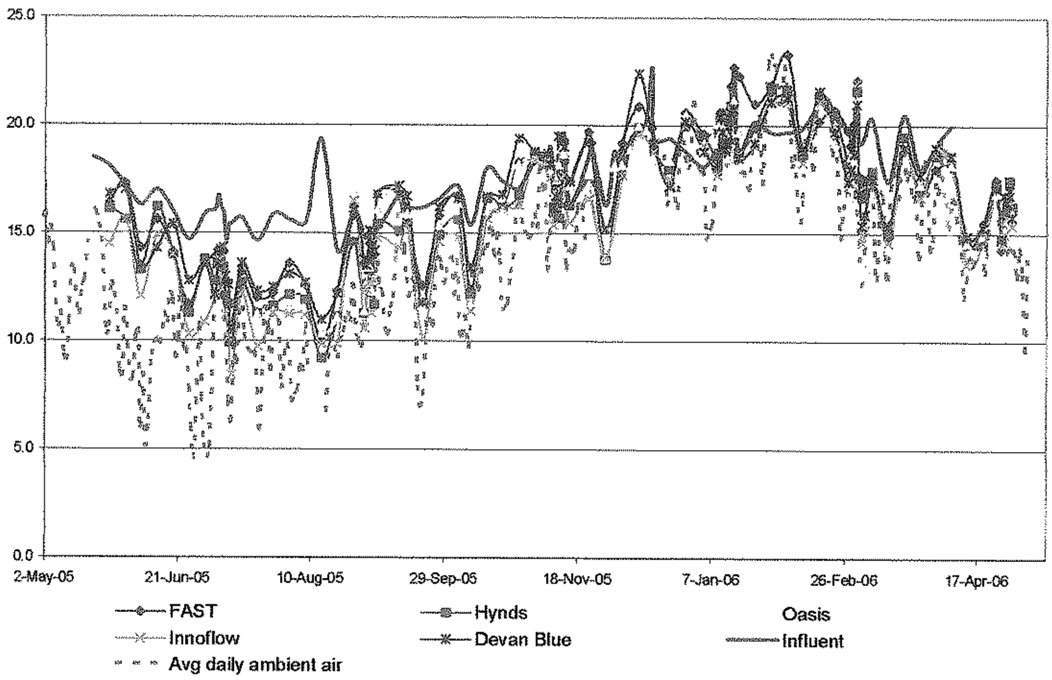

Figure 8 Ambient air, influent and effluent temperatures.

Given the current data set it is difficult to tell if temperature is a major limiting factor in the dissimilation process. However, denitrification has been reported to occur as low as 0 °C (Water Pollution Control Federation, 1983).

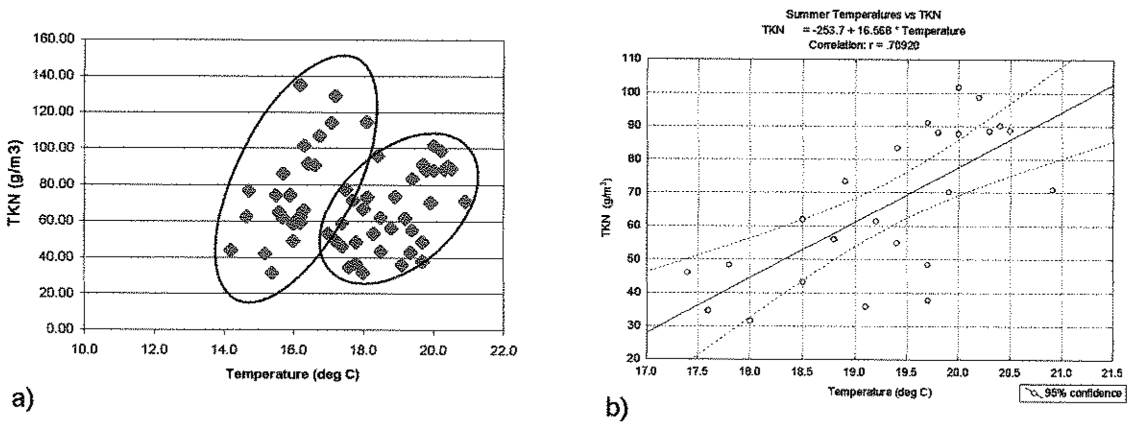

Figure 9 Influent temperature versus TKN for a) over the trial period & b) summer.

The TKN concentration is important as it dictates available carbon in the system to the quality of NH_4-N to be converted. It is possible for hydrolysis/acidogenisis of the influent to be influenced by temperature. Analysis of influent data indicates that the influent make-up has changed with a change in temperature (Figure 9). In Figure 9 (a) when influent temperature is plotted against influent TKN two distinct groups of data are apparent. Inspection of the groups (minus outliers) shows that there was a distinct summer grouping (late November to mid April) and a winter grouping. Correlation of the summer grouping indicates that TKN is temperature related, however no correlation is found for the winter grouping. This would suggest that influent organic loading is more variable over the winter months, potentially impacting on the nitrification process.

5 Conclusion

A trial of five different advanced on-site effluent treatment systems has successfully provided information of the ability of these systems to reduce the components of domestic sewage. The focus of the trial was on the reduction of total nitrogen to meet the limits as stated in Environment Bay of Plenty and Environment Waikato regional plans.

The lowest limit of 15 g/m^3 from rules 11 and 13 of Environment Bay of Plenty's On-Site Effluent Treatment Regional Plan 2006 was achieved by all systems in this trial, however only one system, Innoflow's Orenco AdvanTex® AX20, could sustain this target. Most other advanced systems did however meet the Environment Waikato regional plan target of 25 g N/m^3. Devan Blue's DB9000 NRS had a median TN of 26 g/m^3 (± sd 13 g/m^3), but this may be an artefact of a woodchip based filter which failed. Likewise the Oasis 2000 systems results were affected by a blockage during the trial.

All systems successfully achieved the limits for BOD_5 and SS as set by Environment Bay of Plenty's and Environment Waikato's regional plans.

Systems took around 16 weeks to stabilise before nitrogen reduction levels around target levels were reached. When this wasn't achieved it became apparent that incorrect installation or system malfunctions had caused nitrogen reducing capacity to be compromised.

Environmental factors influencing the trial with the potential to compromise the efficiency of the advanced OSET systems to reduce nitrogen were explored. These potential problems included micro-organism inhibition due to toxicants in the influent, temperature extremes, variation in alkalinity, and influent concentrations and loading. It is concluded that environmental factors did not have much bearing on trial results as they were the same for all systems and some systems achieved excellent nitrogen reduction.

Influent quality does not seem to have been a factor affecting the nitrification-denitrification process. However, influent is more variable over the winter months than summer. This difference is temperature driven and may affect the functioning of some systems. While temperature may affect nitrification/denitrification, the major limiting factors are alkalinity, pH and possibly the carbon content of the influent.

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7 Appendix I

Log Book – Record of visits to and work done on systems.

OSET Log Book

Ref No.	Date	Time	Person/ Company	Nature of Visit	Comment
1	20/05/05	7:00	Andy B	Vf drive tripped	Reset drive and PLC. Pump unblocked system back on line by 10:00am
2	23/05/05	9:30	Jack LeComte	Unblock pump 5	Blocked with rags
3	26/05/05	9:00	Jack LeComte	Unblock pump 4	Line from pump blocked, cut line fit mac union.
4	31/05/05	11:00	Devan Blue	System 5 had no power	Bplug in shed not in properly.
5	10/06/05	8:30	Mark Mohi	Vf drive fault	Fitted extension to system 5 pipe. Leak in last joint (KJ/SB informed Devan Blue. System 4 Kwh meter to be checked. (Townley Elect.
6	13/05/05	10:15	Devan Blue	Insalled plate clarifier	Installed plate clarifier into irrigation pump sump. Installed pressure gauge to irrigation filter.
7	13/06/05	12:10	Devan Blue	Noted nitrate still lowish & Amm. High	Change setting X 2 Aeration.
8	21/06/05	10:30	Hynds Environmental	Check aeration and filters	Zabel blocked so cleaned and replaced
9	23/06/05	8:45	Innoflow	System check	Checked levels;POD growth. Temp monitoring to be set up by AB
10	28/06/05	3:00	Devan Blue	Check out system	Added sep-tech 500ml to aeration tank all well.
11	1/07/05	10:15	Devan Blue	Site visit with Lix Milne for sampling	Ecogent Karl & Bill visit lab for latest results.
12	6/07/05	16:00	Jack LeComte	System 5 not using Kwh	Found main switch on unit "OFF" turned on.
13	11/07/05	15:30	Andy B	Increase pump rates	Increased min speed P1 - 18 to 25: P2 - 17 to 25: Done to increase daily flow up from 930 litres per day.
14	19/07/05	14:30	Oasis	Commissioning System 3	
15	20/07/05	8:45	Tony Hamon	All pumps tripped	Reset system
16	21/07/05	15:00	Smith & Loveless	Checked system found Aeration fault.	Put up sign
17	22/07/05	10:00	Smith & Loveless	Fixing system problem	Adjusted aeration pipe by raising 100mm. Need to return later to do electrical mod.
18	22/07/05		Niki J & John B	?? Hynds	Checked aeration; changed valve for clarifier (ball to gate). Cleared zabel & irrigation filter. Zabel filter blocked.
19	23/07/05		Smith & Loveless	Checked system after pump pipe changed	
20	28/07/05		Smith & Loveless	Pump pip[e unit cut shorter	
21	29/07/05	7:00	Andy B	No flow	Fault on level probe no flow till 10:00
22	29/07/05	10:00	Andy B		Increased min speed P1 - 25 to 30: P2 - 25 to 30: max speed P1 - 79 to 85: P2 - 63 to 70.Done to increase daily flow up from 930 litres per day.
23	29/07/05	11:00	Smith & Loveless	Process Check	Checking unit after alteration made yesterday
24	29/07/05		Hynds Environmental	Visitors escorted to plant by JD.	Complaint received 1/8/05 re visit and S&L working on their unit.
25	15/08/05	9:30	Andy B	Pumps tripped	Reset back on line 9:30am
26	15/09/05		Devan Blue	Clean service system	
27	28/09/05		S&L	System tripped - entire system removed pump connection	
28	29/09/05		S&L	All working again	
29	5/10/05		Hynds Environmental	General check	All good
30	5/10/05		Townley Elect	Change date for daylight saving	

31	11/10/05		Devan Blue	Service	Clean filters
32	28/10/05		Oasis	Check System	
33	7/11/05		Devan Blue	General check	
34	16/11/05		Hynds Environmental	6 monthly service	Beauty
35	17/11/05		Oasis	F/T sludge return and clean	All good
36	22/11/05		Townley Elect	Connect up Super treat	
37	23/11/05		S&L	Sampling influent & Effluent	
38	15/12/05		S&L	General check	Grab sampling
39	21/12/05		Devan Blue	Install new replacement system	
40	23/01/06		Biolytix	System Commissioning	
41	26/01/06		Devan Blue	General check adjust recycle time	cool
42	9/02/06		Oasis	Unit overflowing	
43	16/02/06		Devan Blue	Install clarifier unit to pump out stage	even more cool
44	20/02/06		Biolytix	Paint lid white	
45	23/02/06		Devan Blue	Check clarifier seal cable junction	
46	27/02/06		Devan Blue	Sample taken	
47	1/03/06		Hynds Environmental	Service reset sludge return	
48	7/03/06		Devan Blue	Sampling influent & Effluent	
49	??		Devan Blue	Remove polishing filter	
50	5/05/06		Hynds Environmental	General check	
51	1/06/06		Devan Blue	Relocate flow meter	

(2)

Environment Bay of Plenty

Report From: Bruce Gardner
Pollution Prevention Manager

Date: 26 November 2007

File Reference: 5540 A01

The Chairman and Members

Regulation Monitoring and Investigation Committee

Meeting of 4 December 2007

Advanced Wastewater System Trials at Rotorua Wastewater Treatment Plant

The purpose of this report is to update the Council on onsite household wastewater treatment systems that meet the permitted activity standard in the onsite Effluent Treatment Regional Plan, and the trial's development.

1 Introduction

High nutrient levels put at risk the quality of some of our waterways, estuaries and lakes. Household septic tank systems contribute to these high nutrient levels.

Since the Onsite Effluent Treatment Regional Plan 2006 became operative, the installation of new conventional septic tank systems anywhere in the Rotorua lakes' catchments is discretionary. Existing septic tank systems will become discretionary from December 2010 (not including Tarawera, Hamurana and Rotoma). Advanced onsite wastewater systems are permitted provided that they can meet specified treatment standards.

In order to get some credible data on the performance of locally available wastewater treatment systems in New Zealand conditions, Environment Bay of Plenty facilitated the establishment of a test facility. Contributions towards this were obtained from Environment Waikato, Rotorua District Council and the trial participants.

Figure 1 shows the test setup for the 2007/2008 trial.

2 Past trials

The trial was established to test the performance of advanced wastewater treatment systems associated with a domestic dwelling. The first trial started in May 2005 for a period of six months, and the second trial ran from October 2006 to July 2007. So far 14 different wastewater treatment models have been tested.

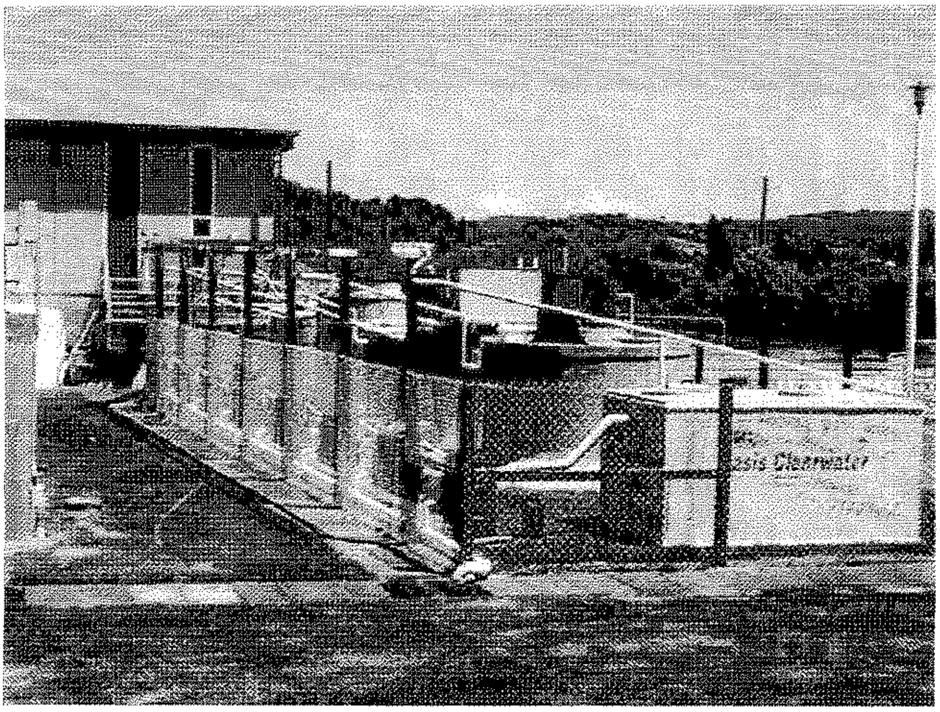


Figure 1 *2007-2008 trial site*

Of the 14 systems, only four met the total nitrogen (TN) standard required for the Rotorua catchment. These are:

- Innoflow Advantex AX20
- Supertreat SB 440 (n12)
- Hynds Lifestyle 'Ultimate'
- RX Plastics AirTech NR

3 Trial 2 Results[1]

This trial ran from October 2006 to July 2007.

Table 1 *Average TN Reduction over 16 consecutive samples (3 month evaluation period)*

Treatment System	Average TN Reduction	Number of TN results 15 g/m^3 or less (out of 16)
1	76%	4
2	80%	5
3	84%	14
4	88%	16
5	61%	0
6	81%	3
7	66%	0

[1] The 16 consecutive best results are chosen for evaluation purposes for each system and the periods do not correspond directly.

Table 2 *Average power consumption and daily flow (over three month evaluation period)*

Treatment System	Average daily power consumption (kWh)	Estimated annual electricity cost ($)[2]	Irrigation pump (kW)	Average daily flow (litres)
1	2.8	215	0.4[6]	828
2	2.5	192	0.1	901
3	2.2	169	0.4	934
4	5.1	391	0.6	804
5	4.9	353	0.6	819
6	1.3	100	0.9	910
7	8.7	667	0.59	862
Innoflow (AdvanTex) AX20[3]	0.6 (1.2[4])	46 (92[4])	none	-
Supertreat SB440[3]	10.8[5]	828	0.6	-

In addition to the six day sampling, additional daily sampling was also carried out over three weekly blocks, at week 8, 16 and 25. Table 3 presents the averages of results for some parameters obtained during this period.

Table 3 *Average biochemical oxygen demand (BOD), faecal coliform (FC) and total suspended solids output (TSS)*

Treatment System	BOD (g/m^3)	FC (cfu/100mL)	TSS (g/m^3)
1	6.1	9.0×10^4	14.5
2	1.3	2.9×10^4	2.7
3	2.9	4.2×10^4	7.4
4	3.0	3.2×10^4	3.8
5	12.1	22.0×10^4	11.2
6	5.1	5.4×10^4	9.3
7	9.8	20.5×10^4	25.8

The two systems in the shaded rows met the Rotorua performance standard in terms of nitrogen reduction. All seven systems met the required standard for (BOD) and (SS) and so may be installed as a permitted activity anywhere outside the Rotorua lakes' catchments.

Average TN reduction ranged from 61% to 88%, while annual electricity costs ranged from $100 to over $600 per year.

[2] Based on a cost per kWh of $0.21 including GST
[3] These systems were approved for installation in Rotorua (permitted activity) based on an earlier trial
[4] Estimated power cost / cost if an irrigation pump was present
[5] According to the supplier, this power figure is much higher than normal, possibly due to a pump blockage. They expected a daily figure of about 4.5kWh
[6] unconfirmed

4 Current Trial (2007 – 2008)

Maintaining uniform flow conditions proved difficult during the early trials. This was largely due to partial blockages in the positive displacement pumps and blockages of the coarse screen in the header tank.

A new trial facility, still located within the Rotorua municipal wastewater plant, has now been established to improve on the earlier trial facility. We have completely redesigned and remodelled the test facility based on the experiences of the past 2 ½ years.

This trial began 12 November 2007 and will run until August 2008.

4.1 Participants

The five companies participating in the current 2007 – 2008 trial are:

(a) Biocycle Holdings Limited

(b) Innoflow Technologies New Zealand Limited

(c) Oasis Clearwater Systems Limited

(d) Smith & Loveless New Zealand Limited

(e) Waipapa Tanks and Waste Treatment Systems Limited

In addition to systems supplied by the above companies we are testing a 4500 l conventional septic tank supplied by Oasis Clearwater.

5 Header tanks

Each treatment system has a dedicated header tank from which 1000 l of waste water is gravity fed to each treatment system. These header tanks, shown in Figure 2, are filled with screened raw wastewater using a submersible pump.

Pressure transducers are used to record the volume of the tanks over time, confirmed that the tanks are filling and emptying as required. Valves controlling the feed of influent to the treatment systems are located on the base of each header tank.

The header tanks deliver wastewater to the treatment systems using gravity by 50 mm pipes mounted on a gantry, as shown in Figure 3.

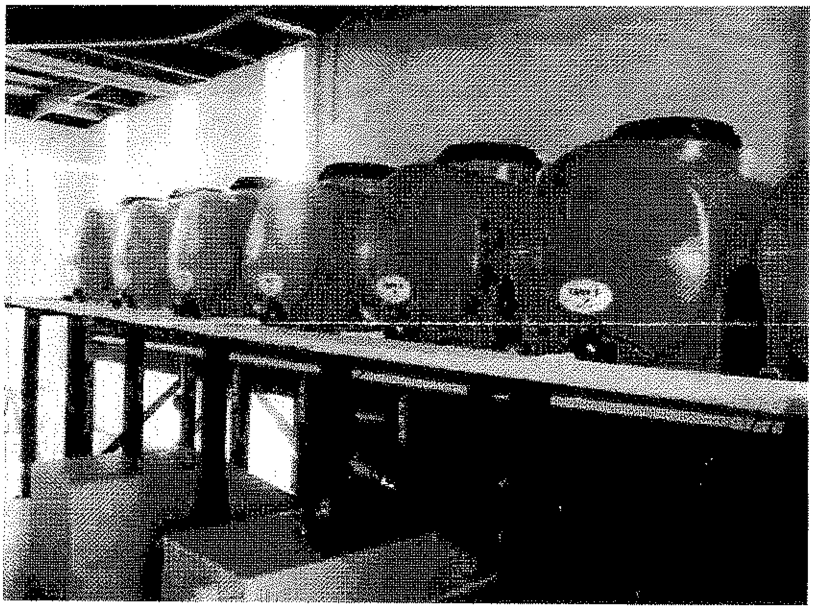


Figure 2 Header tanks

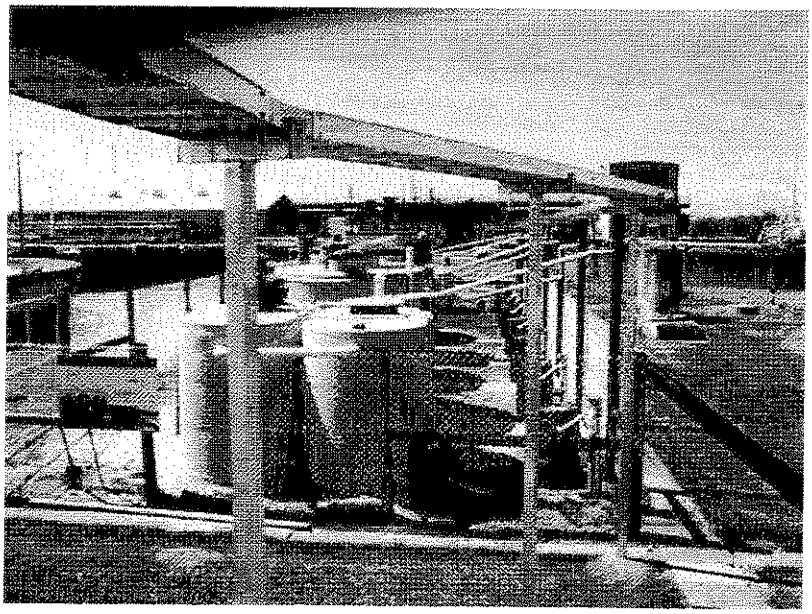


Figure 3 Gantry supporting gravity feed lines

6 SWANS-SIG

Discussions about establishing the trial site as a national testing facility with SWANS-SIG (The Small Wastewater and Natural Systems Special Interest Group of NZWWA) are well advanced. Final funding arrangements are still being determined. The involvement of SWANS-SIG would enable more comprehensive testing of the performance of these systems, including field testing and evaluation of system components.

7 Summary

New conventional septic tanks can no longer be installed in the Rotorua lakes' catchments as a permitted activity. There are now however four advanced wastewater systems approved for installation in these catchments based on earlier trial results. These are:

- Innoflow Advantex AX20
- Supertreat SB 440 (n12)
- Hynds Lifestyle 'Ultimate'
- RX Plastics AirTech NR

Operating costs for these systems vary significantly with annual electricity costs alone ranging from about $100 to over $600.

A completely redesigned trial facility has been established in Rotorua. The current trial commenced 12 November 2007 and will be completed in August 2008. It is testing five advanced wastewater treatment systems and one conventional septic tank.

Report prepared by Sam Weiss, Project Implementation Officer.

Recommendation

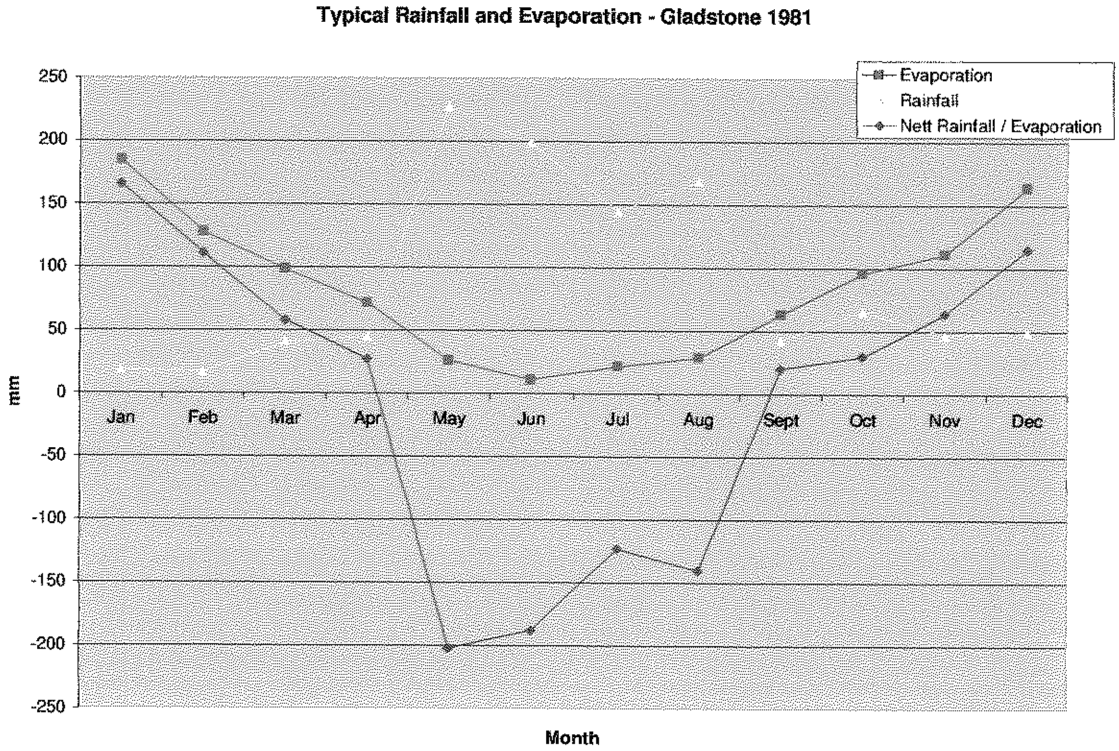
That the Regional Council:

1. **Receives the report.**
2. **Notes that four systems are now approved as permitted for installation in the Rotorua lakes' catchments under the Onsite Effluent Treatment Regional Plan.**
3. **Notes that all seven systems tested in Trial 2 are approved as permitted for installation in the Bay of Plenty region outside of the Rotorua lakes' catchments.**
4. **Notes the significant support from our partner in this project, Rotorua District Council.**

Bruce Gardner
Manager Environmental Coordination

for Group Manager Water Management

Appendix D: Meteorological Data


Typical Rainfall and Evaporation - Gladstone 1981
Evaporation
Rainfall
Nett Rainfall / Evaporation
250
200
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100
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