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Enviropod™ Filter Wairau Rd Trial

Enviropod Holdings limited

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EXECUTIVE SUMMARY

The object of this study is to ascertain the removal efficiency of the Enviropod stormwater filtration system.

The Enviropod system has been commercially available as a stormwater treatment system for 3 years. Over 50 separate projects have been completed in New Zealand and Australia including private sales, test sites and urban road sites.

Enviropod was requested by Auckland Regional Council to provide adequate test data to show the removal rate achievable by the system.

Testing involved assessing the removal rate of a single EnviropodTM filter. The EnviropodTM filter was installed in a catchpit on a highly trafficked road in the Wairau industrial area in North Shore City. After initial assessment it was decided that a 100-micron filter cartridge was the most appropriate for the site.

Automatic water samplers and a flow meter were installed to collect flow proportional stormwater samples before and after the Enviropod unit. Eight separate events were monitored over a seven-month period. Total exported contaminants and flow-weighted means (Event Mean Concentrations, EMC's) were calculated for each event.

Contaminant concentrations of the runoff entering the EnviropodTM filter were highly variable ranging from 0.03 mg/l to 396 mg/l. The contaminant loads generated from the site were lower than expected for a highly trafficked road.

The contaminant reduction for each storm event was variable ranging from 49% to 95%, which is consistent with most treatment devices. The EnviropodTM filter obtained higher removal rates when the runoff entering the EnviropodTM filter had higher mean concentration. The average event suspended solids reduction was 78 %

In examining the inflow and outflow contaminant concentrations over all eight events the average EMC reduction and summation of loads reduction was 81% and 82% respectively.

The efficiency of the EnviropodTM filter compares favourably with traditional forms of stormwater treatment.

INTRODUCTION

The Enviropod™ filter is a catchpit (Gully Pit) insert that comprises of a supporting framework and a replaceable filter cartridge (or filter bag). The Enviropod™ filter removes a high rate of contaminants, requires no construction and utilises existing stormwater maintenance techniques.

Previous studies of the Enviropod catchpit filter system conducted by Auckland City Design have examined the performance of individual Enviropod units, however this was limited to carrying out time proportional sampling and concentration analysis.

The purpose of this study is to determine the removal efficiency of a single Enviropod using a methodology suggested by Auckland Regional Council in order to obtain approval for the use of the Enviropod system as a stormwater treatment solution on new and retrofitted sites.

Limited research has been carried out on the contaminant characteristics of stormwater runoff as it enters the stormwater system (i.e. at the catchpit) or of the treatment efficiency of catchpit inserts. This is largely due to the difficulties of sample collection and flow measurement at the entry point of to the stormwater system.

Objective

The objective of this study is to ascertain the efficiency of an individual Enviropod™ filter. Due the variable nature of stormwater, eight separate sets of samples have been taken representing individual rainstorm events. These rainstorms are intended to cover a range of storms with varied size, intensity and preceding dry period.

Background

In 1997 Enviropod NZ Ltd researched the possibility of point source control of storm water pollution. The purpose of the project was to attempt to develop a cost-effective solution to the growing problem of stormwater pollution in urban areas.

From this the concept, a catchpit filtration device was conceived. The design of the Enviropod was based on the engineering concept of point source pollution control. It was also designed to utilise the existing infrastructure currently used in urban communities.

This infrastructure consists of a stormwater reticulation system, which is serviced, regularly with the use of gully sucker trucks to avoid catchpit and line blockages that can cause flooding and damage to local business and residential areas. The Enviropod™ filter simply increases the efficiency of this system by filtering stormwater runoff before it enters the reticulation system while mitigating against possible pipe blockages.

Enviropod constructed various prototype models and proceeded to conduct numerous trials. When these trials proved successful we obtained a patent for the design. The Enviropod™ filters have been proven in over 50 locations throughout New Zealand and Australia to be efficient at removing gross pollutant and total suspended solids in a cost effective manner with no risk of flooding.

METHODOLOGY

Accurate evaluation of any stormwater treatment device is a difficult process. The nature of stormwater pollutants and subsequent performance of any stormwater treatment device is variable and is dependent on many factors. Catchpit inserts have relatively small catchment areas for each device and therefore experience greater variability in the nature of the stormwater pollutants; this is explored further in the discussion section.

This trial involved evaluating the performance of a single Enviropod. Stormwater was analysed before and after an Enviropod filter was inserted in a catchpit to examine the reduction of contaminants. The Auckland Regional Council approved the following methodology.

Site Selection

A catchpit was chosen on Wairau Road in North Shore City (see appendix A for location and catchment plan). Wairau Road is situated in the Wairau Valley Industrial Zone and is a highly trafficked arterial road (13,000 veh/day). The catchment area does not include any grassed verges and all surfaces are 100% impervious. The surrounding land is a highly urbanised environment with less than 10% vegetation and is restrictive to the retrofit of traditional stormwater treatment methods.

The catchment draining to the Enviropod has a flat grade ($\approx 0.5\%$) and has a catchment area of 774.4m^2 . Stormwater runoff entered the catchpit from essentially one direction.

The Catchpit drains directly to the Wairau Creek approximately 3.5m away, through a 225mm-dia pipe. The creek has been concrete lined. The site allowed only stormwater entering and exiting the EnviropodTM filter to be examined

The site generally is typical of an urban environment with vehicle pollution entering the stormwater network. The site has been chosen so that the results may be extrapolated to most other site situations.

Testing Procedure

Samples were obtained from the gutter immediately before the catchpit and at the discharge point into the creek using automatic samplers (see diagrams in appendix B). All samples were analysed for suspended solids concentration. Samples were also taken from material removed by the filter system and were analysed for moisture content and the filter cartridges weighed.

Methods

Rainfall

The nearest rain gauge is on Sunnybrae Rd, approximately 1km from the Trial area. Rainfall data was obtained from North Shore City Council records for the period covered by the trial.

The time of concentration was calculated to be approximately 8 minutes however a 6-minute time of concentration was adopted to allow comparison with North Shore City rainfall statistics.

North Shore City rainfall statistics only supplied intensities and depths down to a storm with an annual exceedance probability (AEP) of 50% (or a 1 in 2-year storm). Intensities and depths for storms with a higher AEP were extrapolated from the NSCC data. (Appendix C)

Rainfall intensity was calculated from the flow data and catchment characteristics and intensity graphs were produced to find the peak 6-minute average intensity of each storm event (Appendix F). The peak values from these graphs were compared with the North Shore City Rainfall statistics to find the return period for each storm event.

Discharge Recording.

The flow generated from the catchment area of a single catchpit is low i.e. 0.7 l/sec for a 6 minute 1 in 1-month storm¹. A box containing a 90° “V”- Notch weir was constructed and installed across the discharge point to allow accurate measurement of the flow.

A Sigma 900 Max sampler with integrated area velocity flow meter and pressure transducer was installed down stream of the catchpit.

A depth velocity probe was located 40 mm in front of the transition zone. Measurement of the head of water behind the ‘V’ notch weir allowed the calculation of flow. Depth and flow values were determined every 10 seconds and were stored in the data logger within the sampler (Hydrographs for each storm event are attached in appendix D). The velocity logging function was switched off as the turbulence from the standing wave causes variable results.

Water sampling

Stormwater monitoring was carried out over a seven-month period. Two samplers were used to collect the samples before and after the Enviropod. A Sigma 900 Max sampler Collected samples from the outlet pipe. A Manning 4900 automatic sampler collected samples from the kerb. Layout of the samplers is shown in appendix B.

Sampling was initiated at a head of 35mm behind the weir (0.32 l/sec or approximately 1 in 1 week, six-minute storm). The 900 Max sampler controlled the program and the Manning sampler was the slave.

500ml samples were taken every 5 minutes during the first flush and approximately every 1000 litres until the storm ended or until 24 samples were collected. The sampler recorded the time of sample grabs.

Stormwater Analysis

Analysis was carried out by Cooke laboratories in accordance with “*Standard methods of the examination of water and wastewater*”. The Table below outlines the lower detection limits and methods used.

¹ Based on NSCC rainfall statistics.

| <i>Parameter</i> | <i>Method</i> | <i>Lower detection Limit</i> |
|------------------------------------|--|------------------------------|
| <i>Suspended Solids</i> | <i>Filtered using glass fibre, dried at 103° C</i> | <i>1g/m³</i> |
| <i>Total lead, Copper and Zinc</i> | <i>Digestion with nitric Acid/hydrogen peroxide; high-pressure microwave. Atomic absorption spectroscopy</i> | <i>.01g/m³</i> |

Maintenance of Equipment

The trial site has a distinct lack of vegetation surrounding the site. Organics associated with vegetation have the effect of partially clogging the filter surface and reducing the pore size of the filter. In the absence of organics the filter surface remains cleaner and retains its original pore size for a longer period.

Due to this the 100-micron filter was not replaced or cleaned during the length of the trial and no overflow from the Enviropod™ Filter was observed. At the completion of sample collection all sample bottles were cleaned and replaced into the samplers. The cartridge was regularly checked for any rips or cigarette burns.

Data Collection and Analysis

Event Mean Concentrations (EMC's) and Total Exported Contaminates (TEC's) for each storm event were calculated and tabulated in spreadsheet format. The formula used to calculate this data was obtained from the Urban Runoff Data Book. Start and End concentrations were assumed to be 0 mg/l (i.e. zero flow zero concentration). Calculation spreadsheets are attached in appendix E.

Samples of stormwater were taken at predetermined times, and flow was recorded between samples. Samples were then analysed for the concentration of contaminants by an independent laboratory. Storm flows and depth of flow have been measured throughout the storm event and EMC's and TEC's determined.

Analysis has been focused on the suspended solids, as the relationship between suspended solids and other contaminants is identified in many previous studies.

Retained loads

The Enviropod Filter was removed and weighed and emptied twice during the trial. A solid sample was collected and analysed at the Laboratory for moisture content. These results were used to calculate retained loads and are detailed in Appendix G

Calibration of flow

Calibration of depth was undertaken to verify the volume of flow through the monitoring system. Calibration data is shown in appendix H.

RESULTS

Event Details

Stormwater samples were collected between 30/01/00 to 11/08/00. A single Enviropod was installed on the 16/01/00 and fitted with a 100-Micron Podmesh Filter. Eight separate storms were analysed with samples taken before and after the Enviropod unit. Table 1 below contains the event details including inter-event dry period.

| | Date | Storm Duration (hrs) | Total Storm Flow Liters | Samples First Flush | Storm | Dry Period hrs | Return Period |
|-------------|----------|-------------------------|----------------------------|------------------------|-------|-------------------|------------------|
| <u>WS#1</u> | 30/01/00 | 4.65 | 1045.0 | 6 | 1 | 70 | 1 in 2 week |
| <u>WS#2</u> | 12/03/00 | 9.15 | 2187.9 | 6 | 2 | 240 | 1 in 1 month |
| <u>WS#3</u> | 9/04/00 | 23.57 | 1423 | 6 | 1 | 82 | 1 in 1 week |
| <u>WS#4</u> | 7/05/00 | 45.33 | 6827.6 | 6 | 4 | 312 | 1 in 1 month |
| <u>WS#5</u> | 11/05/00 | 11.82 | 12169.7 | 6 | 13 | 84 | 1 in 1 month |
| <u>WS#6</u> | 27/07/00 | 28.65 | 5542.0 | 6 | 5 | 91 | 1 in 3 weeks |
| <u>WS#7</u> | 1/08/00 | 8.18 | 923.3 | 6 | 1 | 53 | 1 in 1 week |
| <u>WS#8</u> | 11/08/00 | 3.5 | 367.7 | 6 | 0 | 154 | 1 in 1 week |

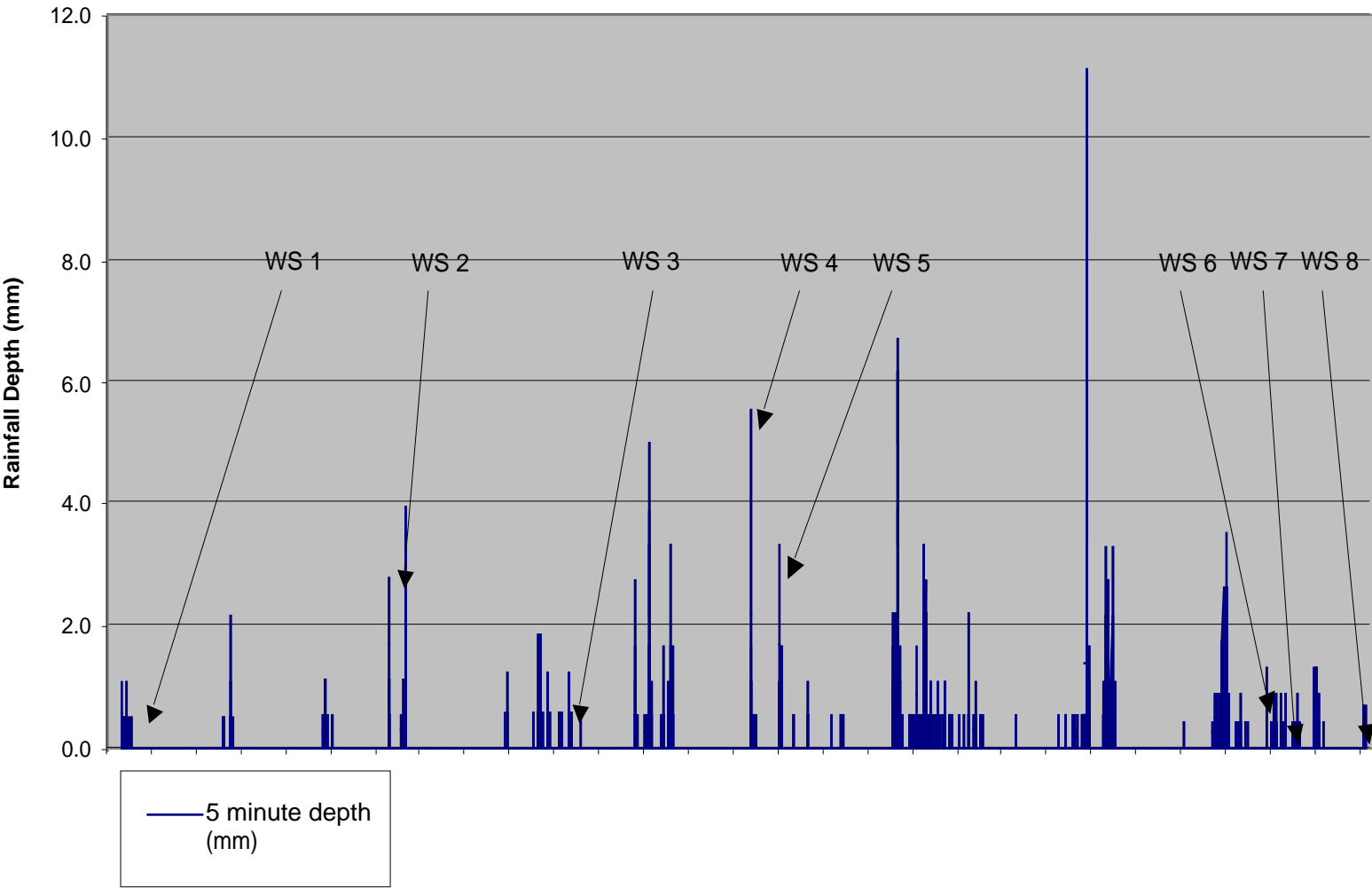
Table 1 Event Details

Chart 1 (following page) shows all rainfall data collected at the Sunnybrae rain gauge, which is approximately 1km from the test site. The chart also labels the storm events sampled.

A comparison of the event depths was carried out. Depths recorded at the Sunnybrae rain gauge and depths derived from the total storm flow logged at the test site were compared (Appendix I). The depth values for each storm event varied greatly with each event. On average the depths recorded at the Sunnybrae station were 46 % larger than the depths derived from the logged data. All events with the exception of storm 7 had a larger depth recorded at the rain gauge than at the test site.

It was not possible to locate the rain gauge in the catchment area of the Enviropod filter and it was decided to use the closest permanent rain gauge (Sunnybrae) 1km away from the test site. Localised weather conditions can greatly effect precipitation on a catchment accounting for the variation in the recorded depths

Rainfall Data - Sunnybrae Rainguage
30 January 2000 - 11 August 2000



Contaminant Concentrations and Total Exported loads

Stormwater samples were collected before and after the Enviropod™ Filter throughout the analysed events. The samples were analysed for the concentration of suspended solids. Total loads transported were extrapolated from the sample concentration and flow weighted means were calculated (event mean concentrations, EMC). Table 2 details these results for each storm event.

| Storm Number | Up Stream SS Conc. (mg/l) | | | | Down Stream SS Conc. (mg/l) | | | | Up Stream SS TEC | Down Stream SS TEC | Up Stream EMC SS | Down Stream EMC SS |
|--------------|---------------------------|-------|-------|--------|-----------------------------|------|------|--------|------------------|--------------------|------------------|--------------------|
| | Max | Min | Mean | Median | Max | Min | Mean | Median | g | g | mg/l | mg/l |
| <u>WS#1</u> | 87.5 | 50.5 | 67.1 | 68.0 | 44.5 | 12.0 | 19.3 | 15.0 | 41.2 | 13.4 | 39.5 | 12.8 |
| <u>WS#2</u> | 376.0 | 43.0 | 161.5 | 124.0 | 16.0 | 0.1 | 8.7 | 11.5 | 230.9 | 12.1 | 105.5 | 5.5 |
| <u>WS#3</u> | 396.0 | 73.0 | 169.7 | 124.0 | 11.0 | 4.0 | 7.1 | 7.0 | 137.0 | 6.8 | 96.3 | 4.8 |
| <u>WS#4</u> | 207.5 | 6.00 | 54.9 | 25.8 | 46.0 | 7.50 | 20.4 | 17.0 | 144.8 | 73.6 | 21.2 | 10.8 |
| <u>WS#5</u> | 99.50 | 2.00 | 34.1 | 25.5 | 34.5 | 0.5 | 7.1 | 4.0 | 266.9 | 55.6 | 21.9 | 4.6 |
| <u>WS#6</u> | 196.0 | 45.0 | 100.7 | 92.00 | 45.0 | 1.0 | 9.9 | 4.0 | 341.1 | 50.0 | 61.6 | 9.0 |
| <u>WS#7</u> | 273.0 | 120.0 | 178.7 | 160.00 | 20.0 | 12.0 | 15.7 | 15.0 | 94.4 | 8.9 | 102.3 | 9.7 |
| <u>WS#8</u> | 333.00 | 60.00 | 127.7 | 86.00 | 84.0 | 20.0 | 50.5 | 51.0 | 47.6 | 19.0 | 129.5 | 51.7 |

Table 2 Contaminant Concentrations and Total Exported loads

Removal load

An examination was carried out on the amount of retained sediment in the Enviropod™ Filter. The filter was weighed and a sample was analysed for moisture content. The results are shown in table 3

| | |
|---------------------------------------|----------|
| Total Wet weight of retained material | 33.20 Kg |
| Total Dry weight of retained sediment | 20.12 Kg |
| Moisture Content | 39.4 % |

Table 3: Weight of retained material in filter bag.

The summary of retained solids has been tabulated and is included in appendix G.

Particle Distribution Analysis

A composite sample was taken from up and down stream samples from WS2, WS3, WS4 and WS5. These samples were analysed for particle distribution. Table 4 below details the results.

| Particle Size | WS 2 (Up) | WS 2 (Down) | WS 3 (Up) | WS 3 (Down) | WS 4 (Up) | WS 4 (Down) | WS 5 (Up) | WS 5 (Down) |
|---------------|-----------|-------------|-----------|-------------|-----------|-------------|-----------|-------------|
| <1mm | 5 | 0 | 0 | 4 | 2 | 0 | 18 | 0 |
| 500µ - 1mm | 0 | 0 | 0 | 0 | 12 | 22 | 0 | 0 |
| 125µ - 500µ | 14 | 1 | 0 | 0 | 9 | 7 | 17 | 0 |
| 63µ - 125µ | 5 | 0 | 35 | 3 | 61 | 7 | 12 | 0 |
| 45µ - 63µ | 69 | 93 | 27 | 90 | 16 | 0 | 0 | 0 |
| <45µ | 7 | 6 | 38 | 3 | 0 | 64 | 53 | 100 |

DISCUSSION

Events, Contaminant Concentrations

Storm events were collected over a 7-month period, covering a range of seasonal variations, storm durations and intensities. Contaminant concentrations varied greatly from .03 mg/l to 396 mg/l. This can be expected, as the catchment area of the Enviropod Filter was only 774m². The Variability of contaminant concentration in runoff is magnified in small catchments and associated low runoff volumes. i.e. a small and isolated increase in a deposited contaminant within the catchment can greatly increase the concentration e.g. a sediment spill from a passing truck.

A first flush effect was evident in the upstream concentrations. Examination of the upstream concentration against cumulative flow revealed that all storms peaked in concentration within the first 21% of runoff.

Chart 2 below shows a typical first flush effect for event 7 with the concentration peaking at 273 mg/l of suspended solids in the first 50.6 litres of runoff

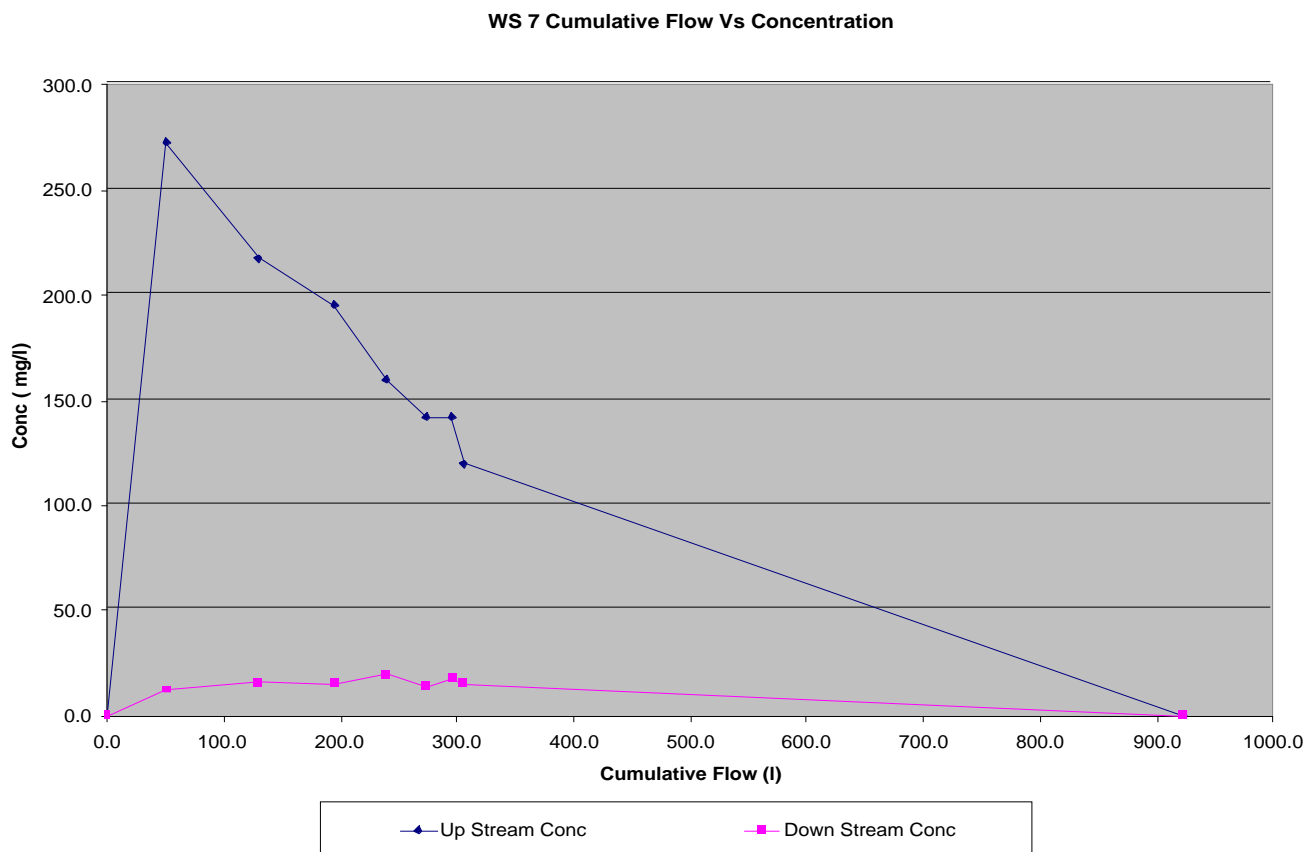


Chart 3 WS 7 Cumulative Flow Vs Concentration

Contaminant Removal Efficiency

The efficiency of a stormwater treatment device can be analysed by comparing the relative contaminant input and output to and from the device. Contaminant levels can either be measured by concentration, or by the total exported load.

Efficiencies were analysed for individual storm events and over the range of sampled events. Three separate methods were used to calculate suspended solids removal efficiency in this trial. They are as follows.

Event Contaminant Reduction

Total Exported Contaminants (TEC's) and Event Mean Concentrations (EMC's) were calculated for each event. These two measurements of contaminant levels were directly proportional as site restraints only permitted one flow meter to be installed on the down stream sampler. Table 3 details the EMC reduction for each event and the range, median and mean reduction.

| Event | Date | EMC Reduction (%) |
|------------------|----------|----------------------|
| <u>WS#1</u> | 30/01/00 | 67% |
| <u>WS#2</u> | 12/03/00 | 95% |
| <u>WS#3</u> | 9/04/00 | 95% |
| <u>WS#4</u> | 7/05/00 | 49% |
| <u>WS#5</u> | 11/05/00 | 79% |
| <u>WS#6</u> | 27/07/00 | 85% |
| <u>WS#7</u> | 1/08/00 | 91% |
| <u>WS#8</u> | 11/08/00 | 60% |
| Min Reduction | | 49% |
| Max Reduction | | 95% |
| Mean Reduction | | 78% |
| Median Reduction | | 82% |

Table 4 Event Contaminant Reduction

The results show a large amount of variability in EMC Reduction. An examination of the inlet EMC and Event Efficiency was carried out. Chart 3 plots the inlet EMC against the Efficiency. The chart shows higher removal efficiency for storms with higher inflow EMC. This performance characteristic is common with stormwater sand filters, however limited research has been carried out on the Phenomena².

² Horner, R. and Horner, C., Design, *Construction and Evaluation of a Sand filter stormwater Treatment System*, Report to Alaska marine Lines, Seattle,U.S.A,1995

Upstream Concentration Against Efficiency

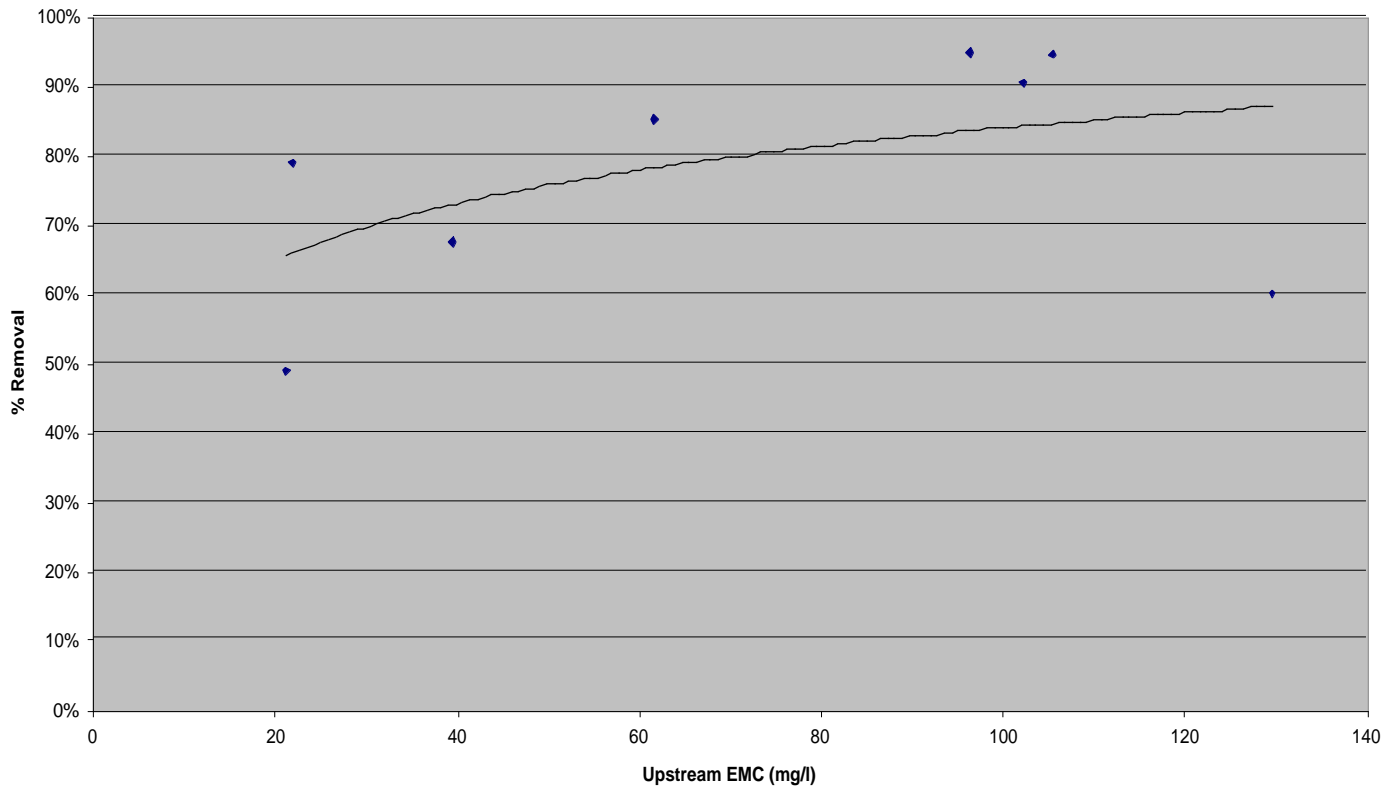


Chart 2 Upstream EMC Vs Event Contaminant Removal

The factors that influence the concentration were examined, namely preceeding dry period, average flow rate, storm duration and average sampled flow, however no direct relationship was evident from the data. Each of these factors can effect the concentration individually or in combination. It is therefore difficult to identify a direct relationship between individual factors and the concentration.

Average EMC Reduction

The Average EMC reduction is defined as:

$$Average EMC Reduction = 1 - \frac{average EMC_{Outlet}}{average EMC_{Inlet}}$$

Over the eight storm events the results were:

| | |
|-----------------------|------------------------|
| Average EMC Inlet | 75.23 g/m ³ |
| Average EMC Outlet | 13.62 g/m ³ |
| Average EMC Reduction | 81% |

Table 5: Average EMC Reduction

Summation of Loads Reduction

The summation of loads reduction is a comparison between the sum of the inlet TEC's and the outlet TEC's, over the eight sampled events. The results are as follows

| | |
|------------------------|-----------|
| Sum of Inlet Loads | 1222.44 g |
| Sum of Outlet Loads | 234.20 g |
| Sum of Loads Reduction | 82% |

Table 6: Summation of Loads Reduction

Efficiency Comparison

Table 7 below compares the efficiency of the Enviropod™ Filter System with other Stormwater treatment device studies. The performance of any stormwater treatment device is variable and dependant on design, site limitations, runoff characteristics and effective maintenance. The removal rates listed below are derived from studies that have examined various installations of each treatment device.

| | Enviropod™ Filter | Stormwater Wetlands | Wet Detention Pond | Vegetated Swales | Stormwater Sand Filters |
|-------------|----------------------|------------------------|------------------------|---------------------|----------------------------|
| TSS Removal | 78% | 67% ³ | 50% - 90% ⁴ | 81% ⁵ | 70% ⁶ |

Table 7: Efficiency Comparison

The table shows the Enviropod™ filter has a comparable performance in removing total suspended solids to existing treatment methods.

Estimated Suspended Solids Loading and Retained Load.

The suspended solid load generated from the catchment can be estimated by multiplying the average upstream EMC over the 8 sampled events with the total rainfall for the monitoring period (measured at the NSCC Sunnybrae rain gauge). The retained load is the total dry weight of material removed from the Enviropod filter over the monitoring period. The loads from the catchment have been presented in 3 ways, Kg, kg/hectare/year, kg/hectare/mm to allow comparison with other results and are shown in table 8.

³ Centre for Watershed Protection (CWP), *Pollutant Dynamics with Stormwater Wetlands: I. Plant Uptake Techniques, Vol.1, No.4*. Silver Spring, USA, 1995.

⁴ Schueler, T.R., *A Current Assessment of Urban Best Management Practices*, Metropolitan, Washington Council of Governments, USA, 1992.

⁵ USEPA, *Stormwater Technology Fact Sheets – Vegetated Swales*, Office Of Water, Washington, USA, 1999.

⁶ Gallie, J., *Peat Sand Filters: A Proposed Stormwater Management Practice for Urbanised Areas* Metropolitan Washington Council Of Governments, USA, 1990.

| Loads from test catchment 30/1/00 –11/8/01 | Dry Weight (kg) | Load / Year (kg/hectare/year) | Load / Rainfall (kg/ha/mm) |
|--|--------------------|----------------------------------|-------------------------------|
| Estimated Suspended solids load from Catchment | 35.6 | 786.8 | 0.61 |
| Retained Suspended solids load from Catchment | 20.1 | 445.2 | 0.35 |

Table 8: Estimated Suspended Solids Loading and Retained Load

Comparing the estimated suspended solids load with the retained load gives an efficiency of 57%. This result is significantly lower than the efficiency calculated from flow proportional upstream and downstream sampling. However as discussed previously the Sunnybrae rain gauge experienced approximately double the rainfall as the testing location. This factor has greatly increased the suspended solids load from the catchment.

The urban runoff data book⁷ estimates the median suspended solids load from highways and motorways as 2.2 kg/ha/mm. This suggests that the loading from the catchment was lower than can be expected. This is attributed to the flat grade of the catchment, which results in lower velocities and in turn less contaminants being transported.

Particle Distribution Analysis

The particle distribution was varied for all 4 storms monitored. Chart 4 shows the average particle distribution compared with other research from around the world⁸. Stormwater sampled in the Wairau Road study had a greater percentage of sand size particles as opposed to the large percentage of silt size particles observed in stormwater from other studies.

Other studies^{9,10} examining the particle distribution of transported sediments into a catchpits (gully pots) and gutter dust have shown coarser particles than samples taken from downstream stormwater pipes.

Results from different studies should be compared with caution, as location of sampling and the sampling method are capable of contributing to the observed results. Results obtained from the Wairau Rd trial were obtained by placing the upstream intake tube to face downstream and drawing the sample against the flow, allowing truly suspended material entering the stormwater system to be collected.

It is suggested that particles being transported in sediment may reduce in size as they travel down the stormwater system as a result of turbulence and hydraulic conditions. However the mechanisms involved in transportation of stormwater sediments are not fully understood.

⁷ Willimanson, BW. *Urban Runoff Data Book*, Water quality Centre publication No 20, Hamilton, NZ, 1991

⁸ Auckland Regional Council, *An Assessment of Stormwater Quality and the Implications for the Treatment of Stormwater in the Auckland Region*, ARC Environment and Planning Division Technical Publication 5 Auckland Regional Council, Auckland, 1992

⁹ Pratt And Adams 1982

¹⁰ Auckland Regional Council, *An Assessment of Stormwater Quality and the Implications for the Treatment of Stormwater in the Auckland Region*, ARC Environment and Planning Division

Generally downstream samples had a greater percentage of silt size particles. This can be expected as the larger particles had been removed by the Enviropod filter, giving a higher proportion of finer particles. Three out of the four storm events sampled showed particles greater than the poor size of the filter down stream. Possible explanations for this are as follows:

- β The Enviropod filter was allowing a small percentage of inflow to bypass the filter most probably through the overflow
- β Engagement of the over flow.
- β Overflow of the creek. The outlet pipe was located approximately 1 metre above Wairau creek. The creek periodically overtops the outlet pipe in storm conditions.
- β Debris entering the box containing the V-notch weir. The flow was recorded through a V-notch weir attached to the end of the outlet pipe. The box containing the V-notch was open to the elements and situated at the bottom of an embankment. It is possible that material may have entered the box.

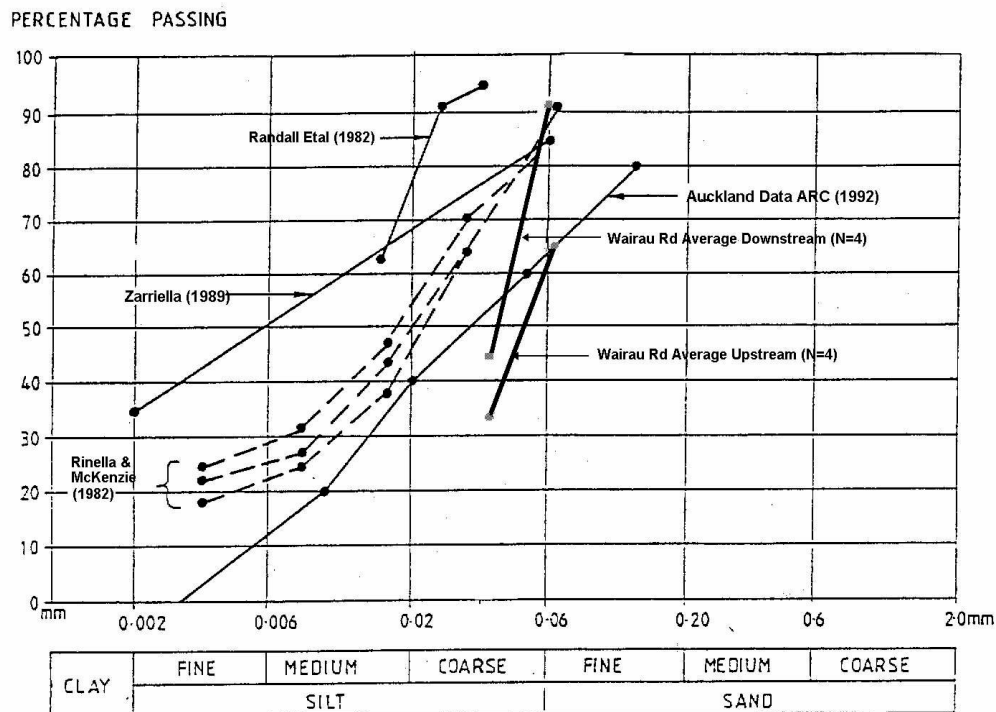


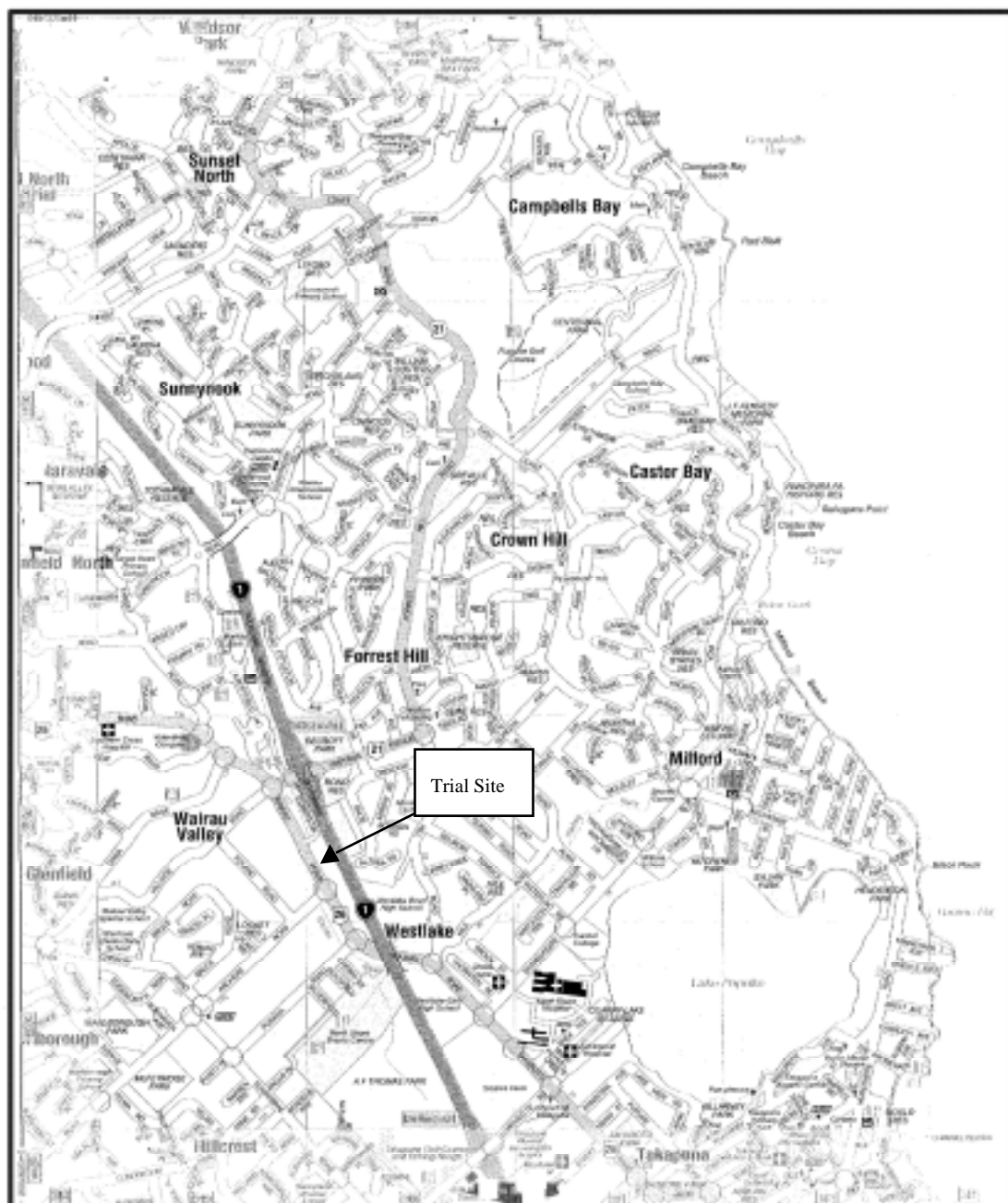
Chart 4 Comparative Particle Size Distribution

SUMMARY AND CONCLUSIONS

- Over the range of conditions analysed in the study, the Enviropod™ filter consistently reduced the total suspended solids being transported into the stormwater system.
- The contaminant concentration of runoff entering the Enviropod™ filter was highly variable.
- The average suspended solids reduction for a rainstorm event was 78%.
- The average event mean concentration reduction over the 8 events examined was 81%.
- The total exported load reduction was 82% over the 8 events examined.
- The event suspended solids reduction was variable. Ranging from a low of 47% to a high of 96%.
- The Enviropod™ filter obtained higher removal efficiency of events with higher contaminant concentration. This phenomena is constant with other treatment devices especially filters.
- The estimated contaminant loadings being generated from the catchment were low for a highly trafficked urban road.
- Samples collected from stormwater at the kerb showed a greater percentage of sand size particles than observed in other studies, which collected samples from bulk stormwater.
- The Enviropod™ filter compares favourably with traditional stormwater treatment methods.

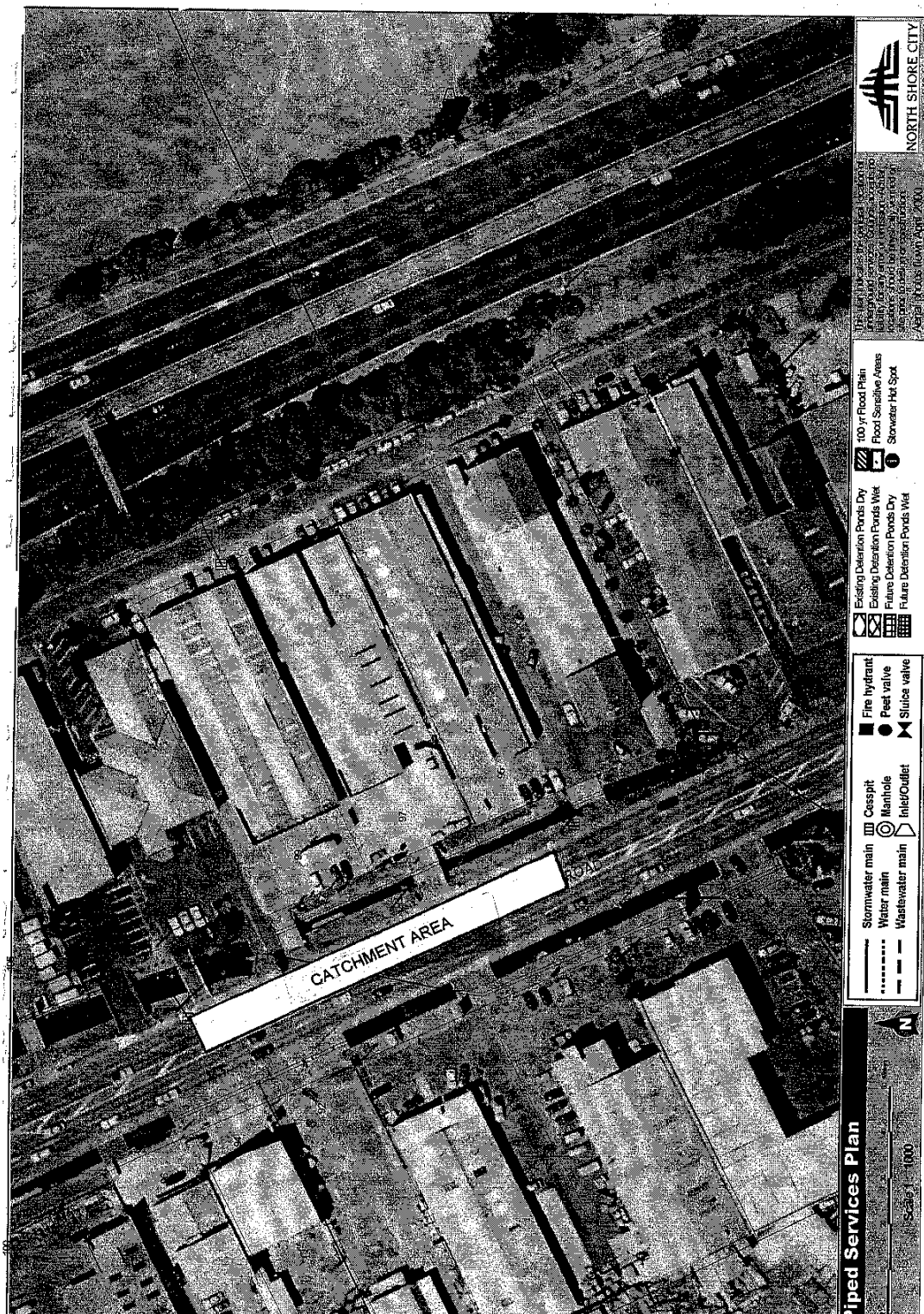
APPENDIX A

CATCHMENT PLANS



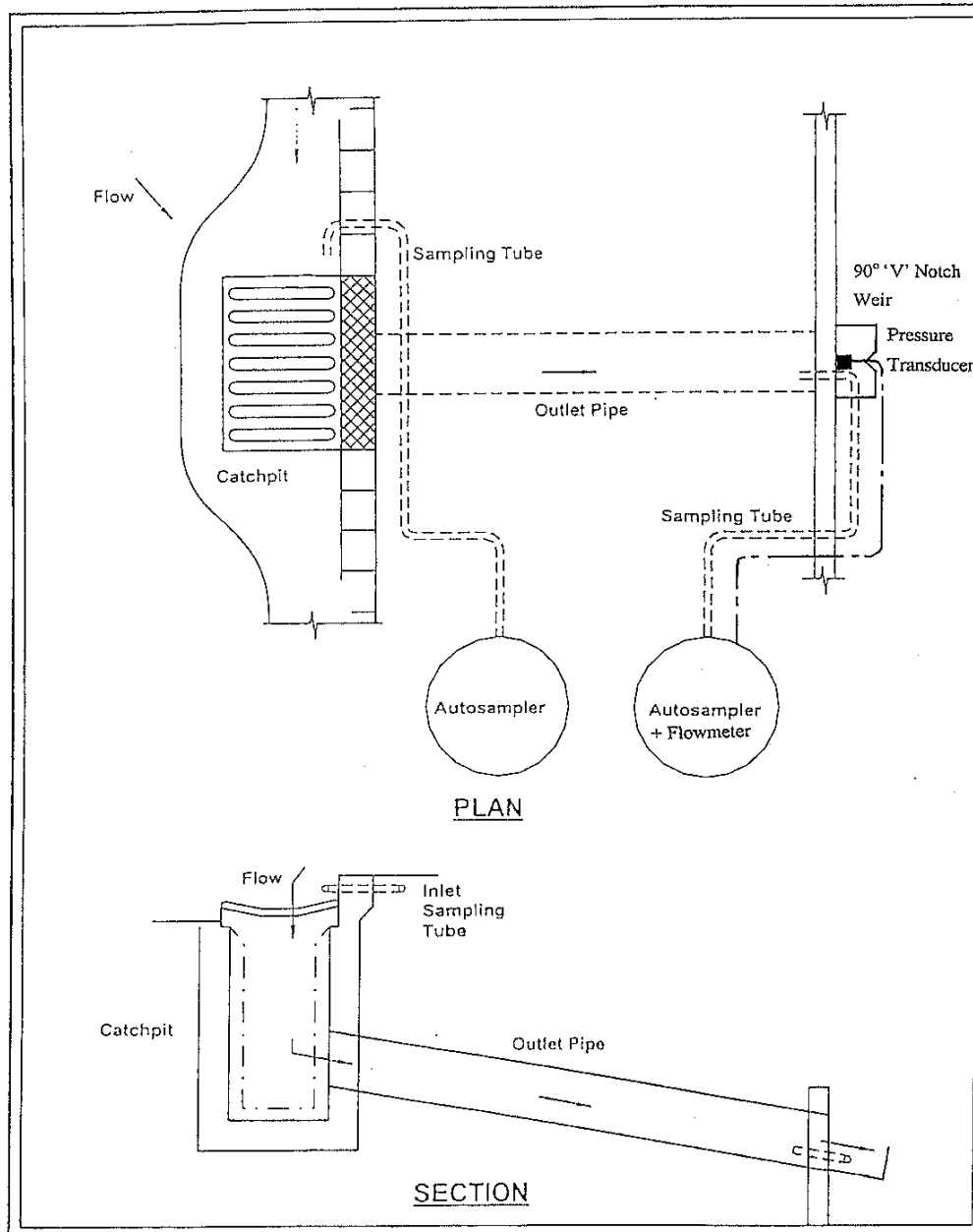
Enviropod Filter Trial – Wairau Rd North Shore

Locality Plan



APPENDIX B

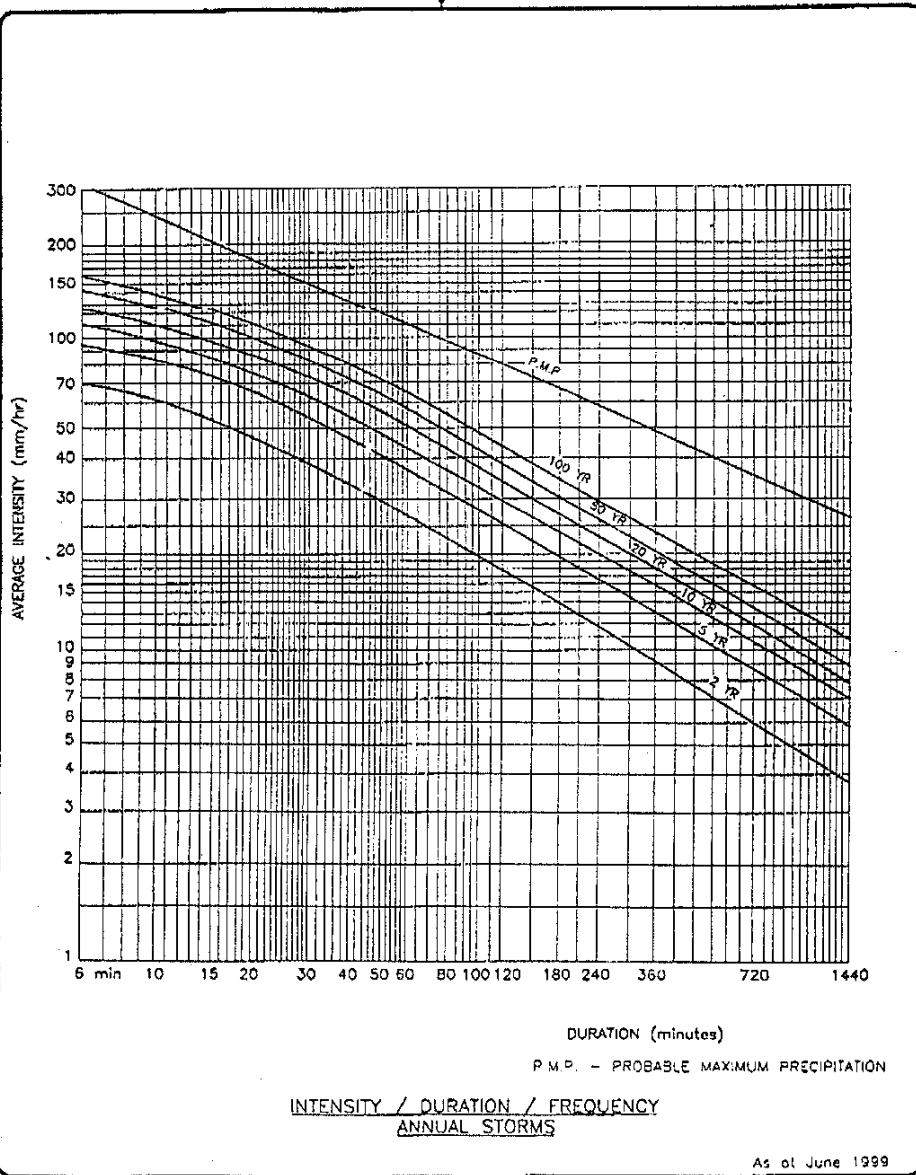
LAYOUT OF TEST SET UP



Layout of Test Set-up

APPENDIX C

RAINFALL STATISTICS



File Name: 00072445

SW 10 RAINFALL INTENSITY GRAPH



ROGER HAWTHORNE
STORMWATER MANAGER

| | |
|-------------|--------|
| Revision | 4/2000 |
| Scale: | nts |
| Drawing No. | 28275 |

Depths in millimeters

| AEP | 6 min | 10 min | 12 min | 18 min | 20 min | 24 min | 30 min | 1 hr | 2 hr | 6 hr | 12 hr |
|-------|-------|--------|--------|--------|--------|--------|--------|-------|--------|--------|--------|
| 50% | 7.14 | 10.14 | 11.67 | 15.10 | 16.06 | 17.98 | 20.09 | 26.89 | 35.12 | 54.22 | 68.53 |
| 20% | 9.55 | 13.68 | 15.75 | 20.71 | 21.98 | 24.53 | 27.57 | 36.41 | 47.87 | 76.80 | 100.00 |
| 10% | 11.15 | 16.04 | 18.48 | 24.47 | 25.96 | 28.93 | 32.57 | 42.78 | 56.40 | 91.93 | 120.96 |
| 5% | 12.66 | 18.25 | 21.05 | 28.01 | 29.69 | 33.06 | 37.29 | 48.79 | 64.44 | 106.18 | 140.69 |
| 2% | 14.63 | 21.16 | 24.42 | 32.64 | 34.58 | 38.47 | 43.46 | 56.64 | 74.96 | 124.81 | 166.40 |
| 1% | 16.11 | 23.34 | 26.95 | 36.12 | 38.26 | 42.54 | 48.10 | 62.56 | 82.88 | 138.84 | 185.76 |
| 0.20% | 19.55 | 28.38 | 32.80 | 44.18 | 46.78 | 51.97 | 58.84 | 76.23 | 101.18 | 171.28 | 230.54 |

Average Intensities in millimeters per hour

| AEP | 6 min | 10 min | 12 min | 18 min | 20 min | 24 min | 30 min | 1 hr | 2 hr | 6 hr | 12 hr |
|-------|-------|--------|--------|--------|--------|--------|--------|------|------|-------|-------|
| 50% | 71.7 | 60.8 | 58.4 | 50.3 | 48.2 | 45.0 | 40.2 | 26.9 | 17.6 | 9.04 | 5.71 |
| 20% | 95.5 | 82.1 | 78.8 | 69.0 | 65.9 | 61.3 | 55.1 | 38.4 | 23.9 | 12.80 | 8.33 |
| 10% | 111.5 | 96.2 | 92.4 | 81.6 | 77.9 | 72.3 | 65.1 | 42.8 | 28.2 | 15.32 | 10.08 |
| 5% | 126.6 | 109.5 | 105.3 | 93.4 | 89.1 | 82.7 | 74.6 | 48.8 | 32.2 | 17.70 | 11.72 |
| 2% | 146.3 | 127.0 | 122.1 | 108.8 | 103.7 | 96.2 | 86.9 | 56.6 | 37.5 | 20.80 | 13.87 |
| 1% | 161.1 | 140.0 | 134.8 | 120.4 | 114.8 | 106.4 | 96.2 | 62.6 | 41.4 | 23.14 | 15.48 |
| 0.20% | 195.5 | 170.3 | 164.0 | 147.3 | 140.3 | 130.0 | 117.7 | 76.2 | 50.6 | 28.55 | 19.21 |

As of June 1999

SW 11
ANNUAL RAINFALL DEPTHS AND
INTENSITIES

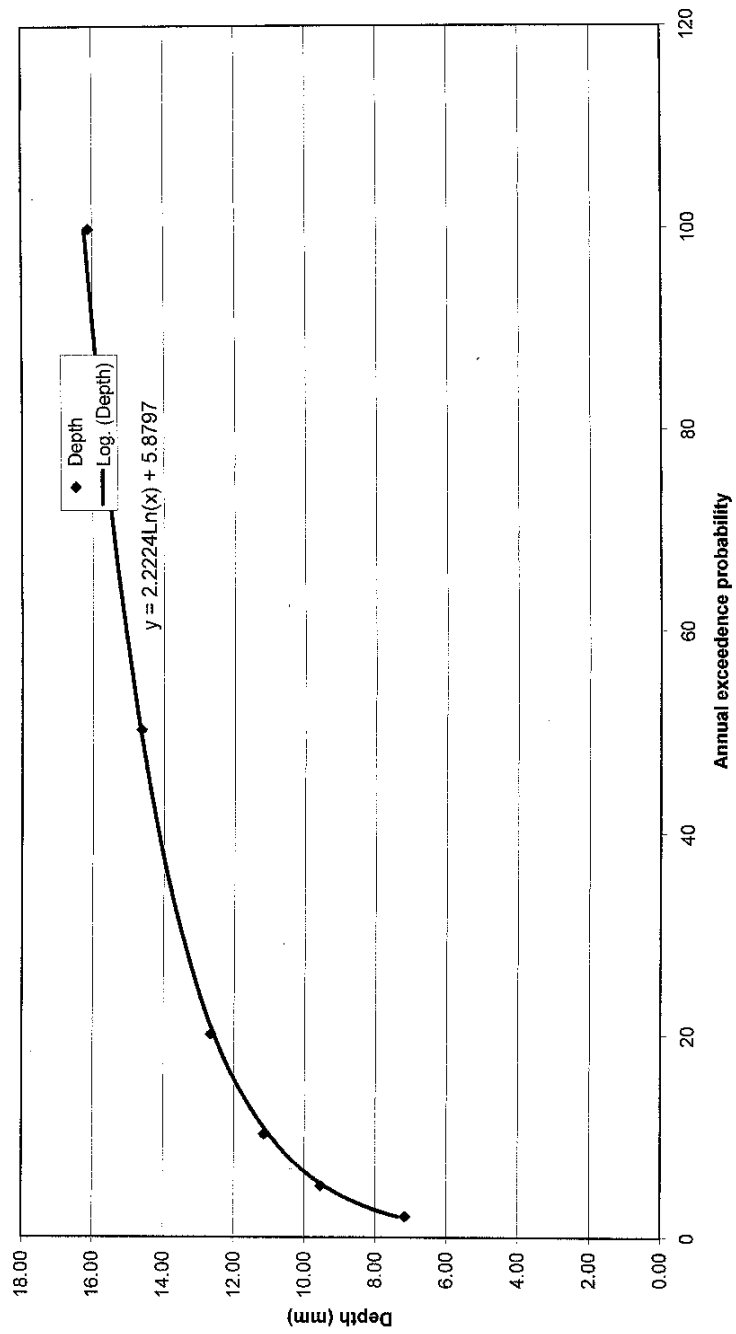
Name: SW11



ROGER HAWTHORNE

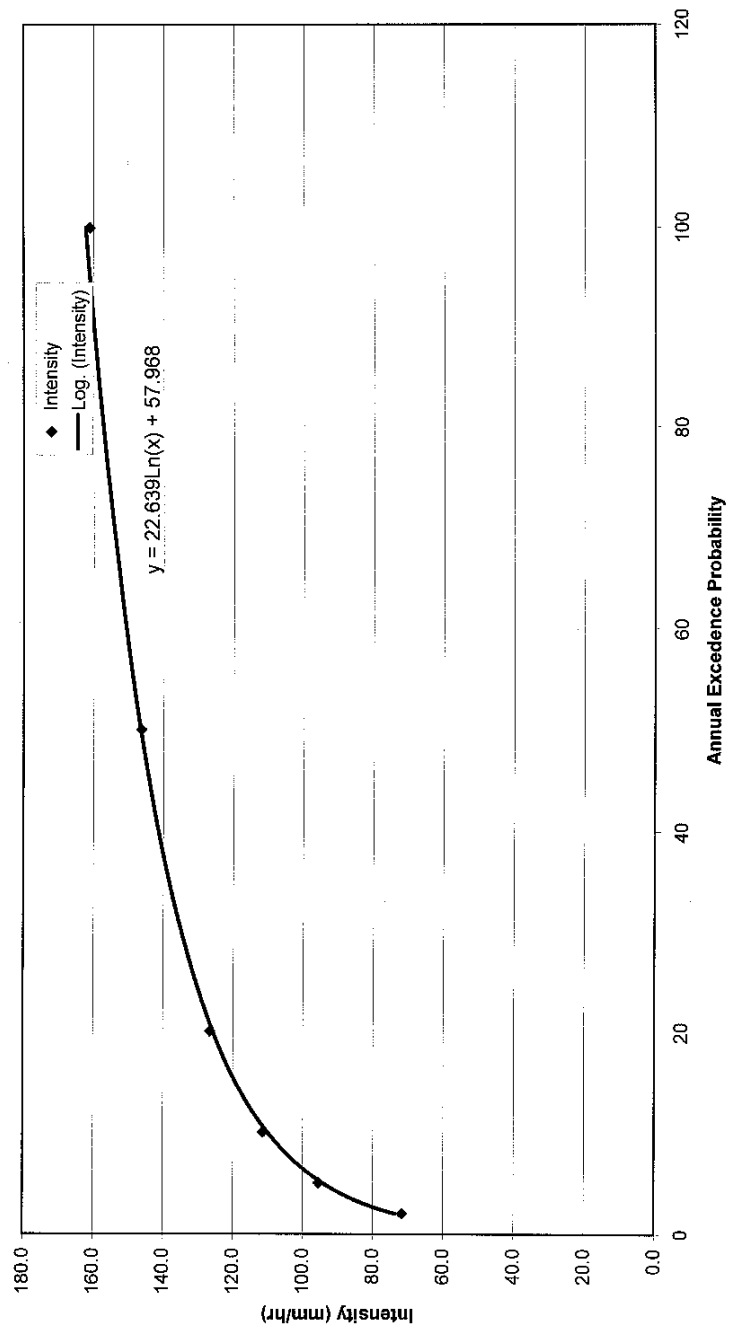
Revision 4/2000
Scale: nts
Drawing No. 78775

ENVIROPOD FILTER TRIAL - WAIRAU ROAD NORTH SHORE CITY Storm depth formula



Peak-flow II

ENVIROPOD FILTER TRIAL - WAIRAU ROAD NORTH SHORE CITY Storm Intensity Formula



ENVIROPOD FILTER TRIAL

WAIRAU ROAD - NORTH SHORE CITY

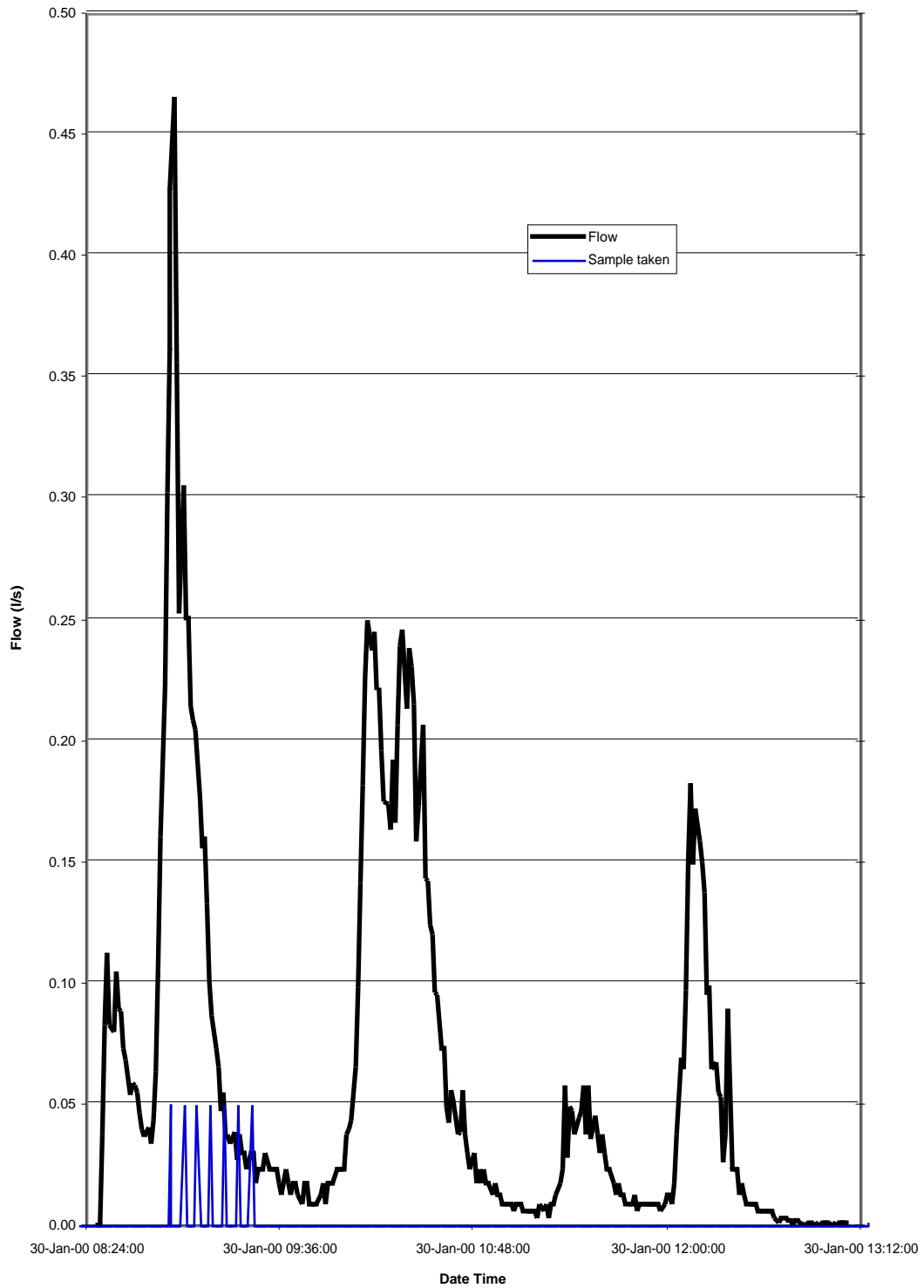
Depth and intensity for storm events less than 1 in 2 year - 6 min

| Probability 1 in Year | Probability 1 in Year | Depth mm | Intensity mm / hr |
|--------------------------------|-------------------------------|-------------|----------------------|
| | 500 | 500 | 19.55 |
| | 100 | 100 | 16.11 |
| | 50 | 50 | 14.63 |
| | 20 | 20 | 12.66 |
| | 10 | 10 | 11.15 |
| | 5 | 5 | 9.55 |
| | 2 | 2 | 7.17 |
| | 1year | 1 | 5.88 |
| | 6 months | 0.50 | 4.34 |
| | 3 month | 0.25 | 2.80 |
| | 2 month | 0.17 | 1.90 |
| | 1 month | 0.08 | 0.36 |
| | 2 weeks | 0.04 | 0.18 |
| | 1 week | 0.02 | 0.09 |

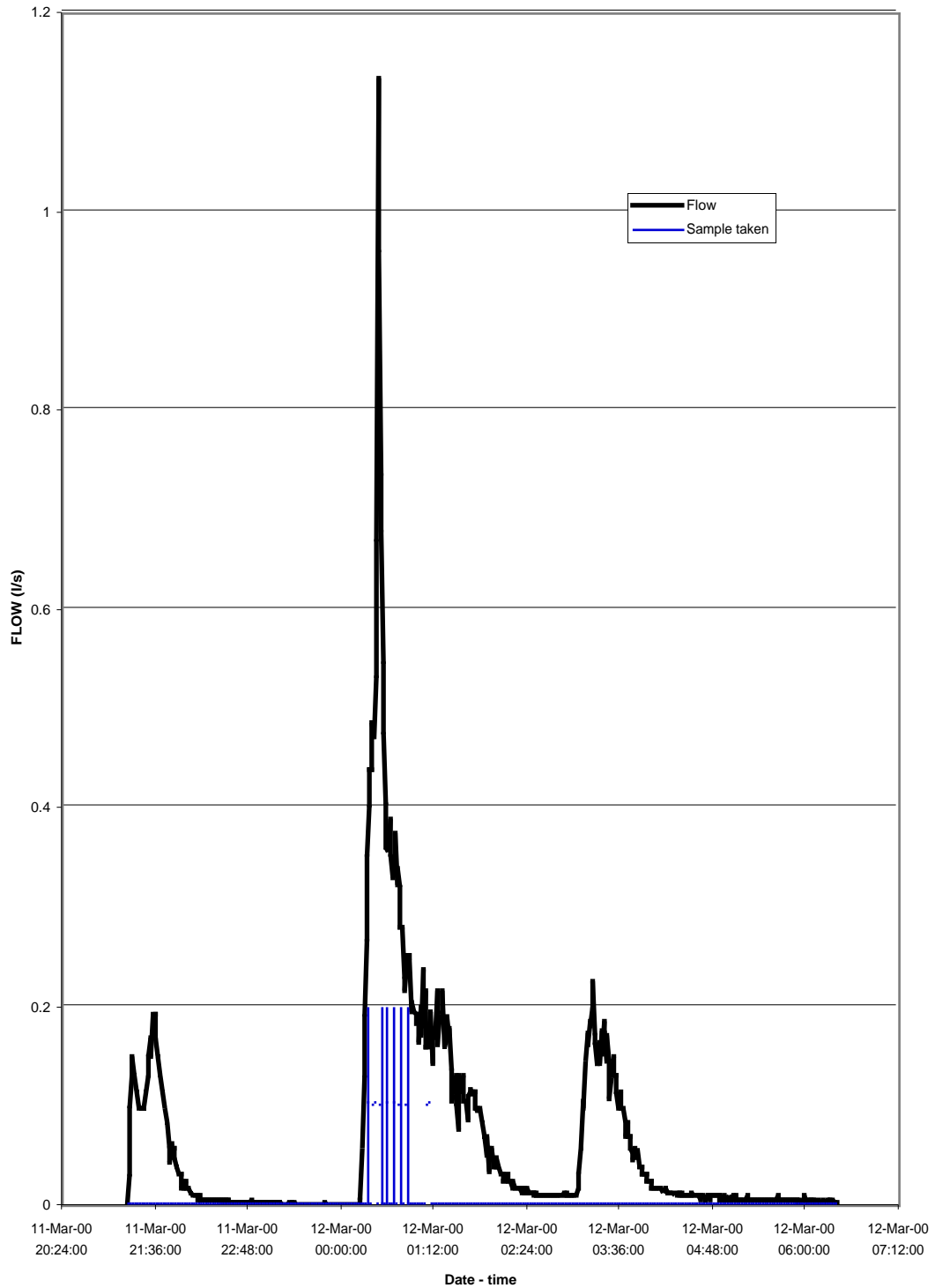
APPENDIX D

FLOW AND SAMPLE TIME GRAPHS

ENVIROPOD FILTER TRIAL - WAIRAU ROAD NORTH SHORE CITY-
Monitored Storm Event #1
Flow and Sample Time

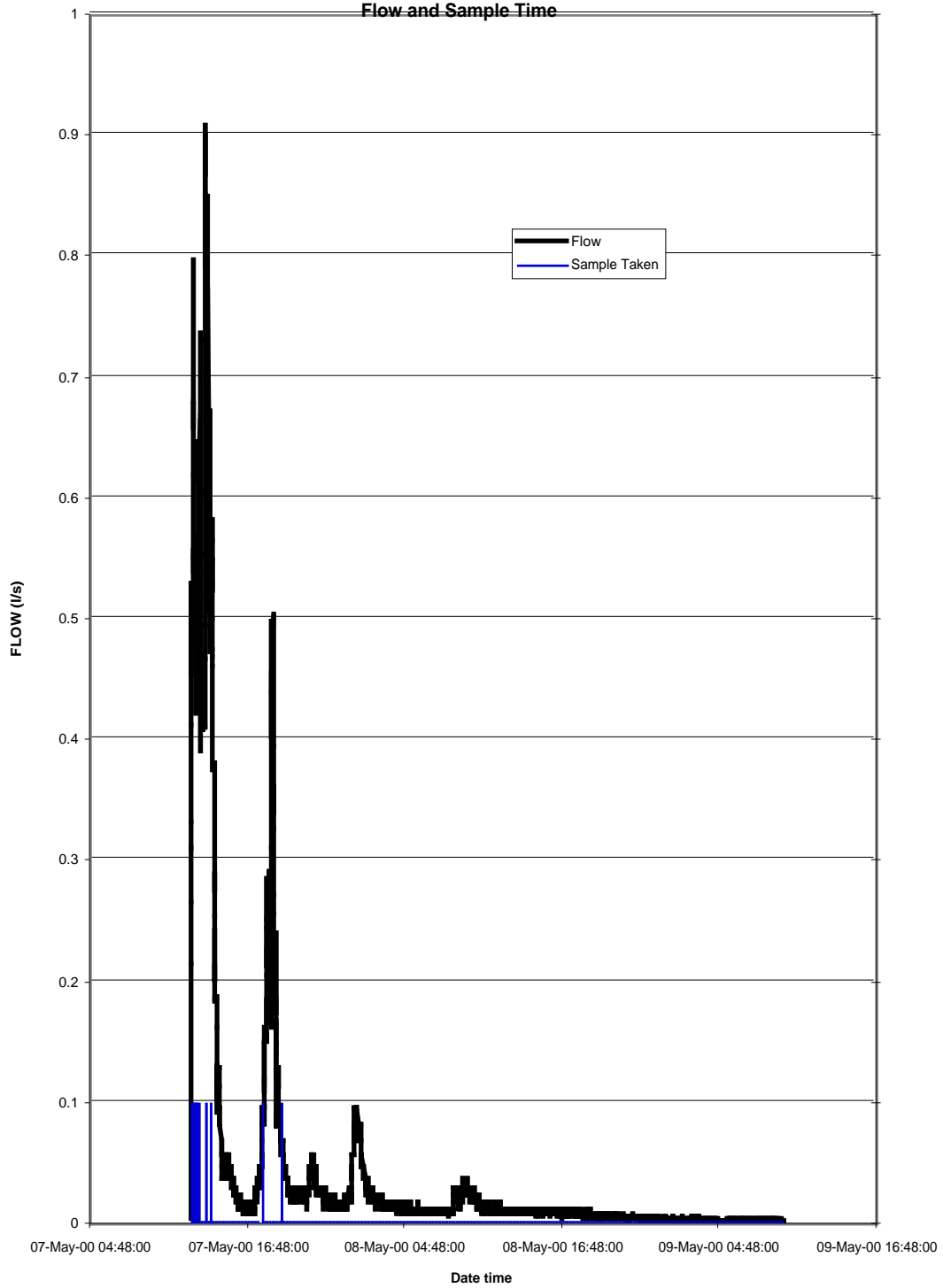


ENVIROPOD FILTER TRIAL -WAIRAU ROAD NORTH SHORE CITY
Monitored Storm Event # 2
Flow and Sample Time

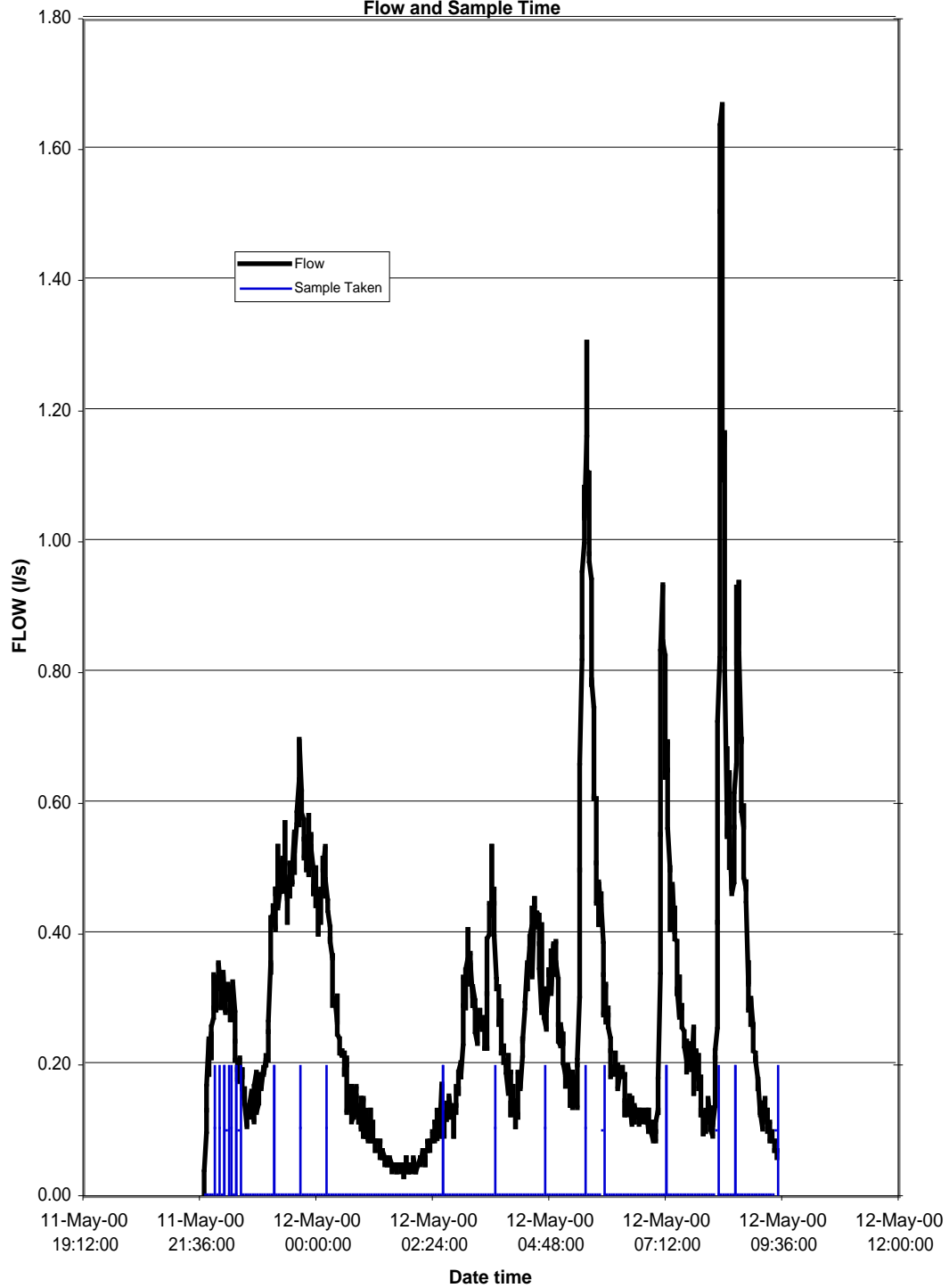


The graph, titled "Flow and Sample Time", plots Flow (l/s) on the y-axis (0 to 0.5) against Time Date on the x-axis (08-Apr-00 22:48:00 to 10-Apr-00 03:36:00). The "Flow" series (black line) shows a major peak of approximately 0.44 l/s at 08-Apr-00 22:48:00, followed by a sharp decline and a smaller peak of about 0.09 l/s at 09-Apr-00 03:36:00. A second, larger peak of about 0.11 l/s occurs at 09-Apr-00 13:12:00. The "Sample taken" series (blue line) remains at zero for most of the duration, with a small peak of about 0.05 l/s at 08-Apr-00 22:48:00.

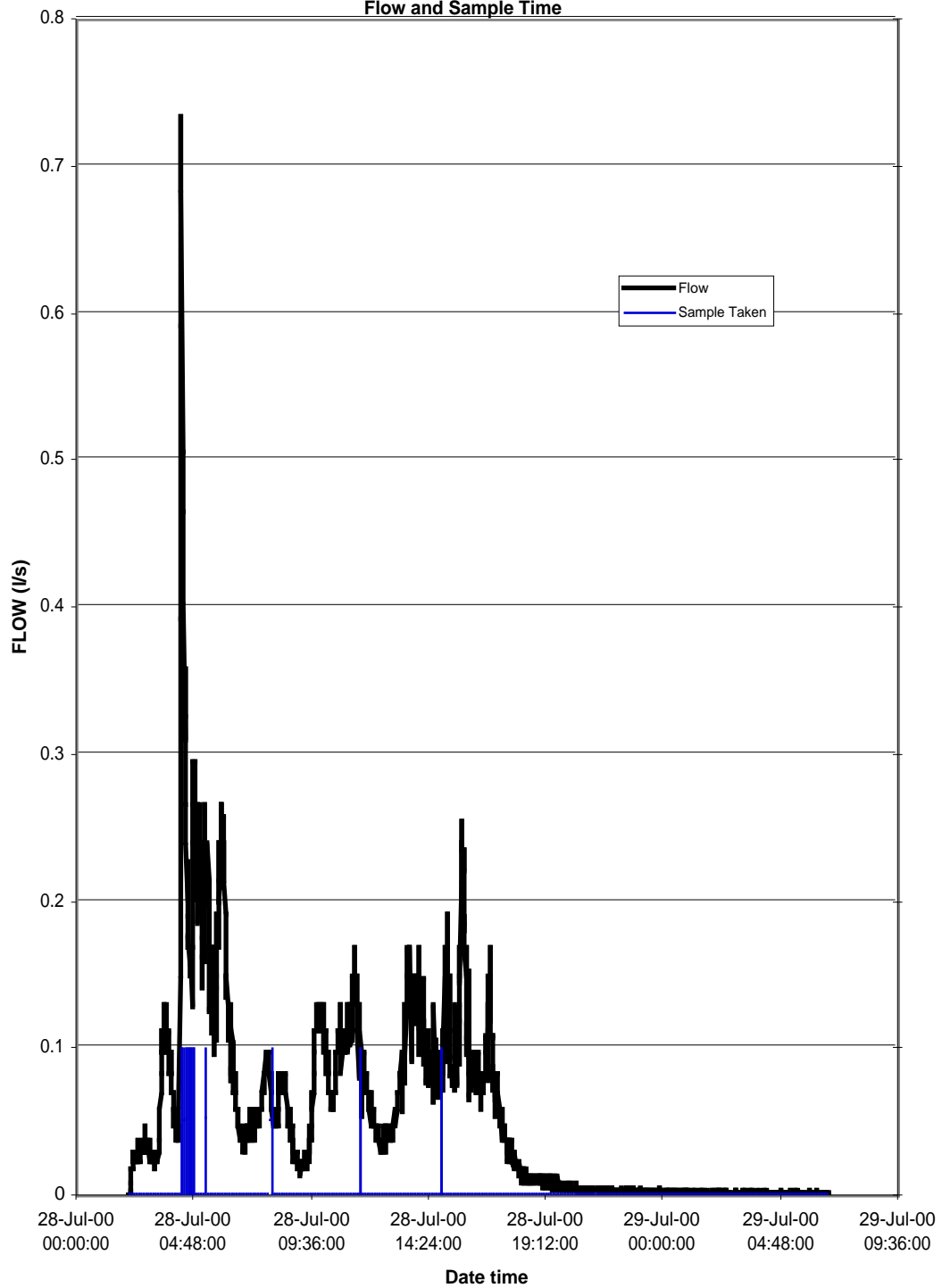
ENVIROPOD FILTER TRIAL - WAIRAU ROAD NORTH SHORE CITY
Monitored Storm Event # 4
Flow and Sample Time



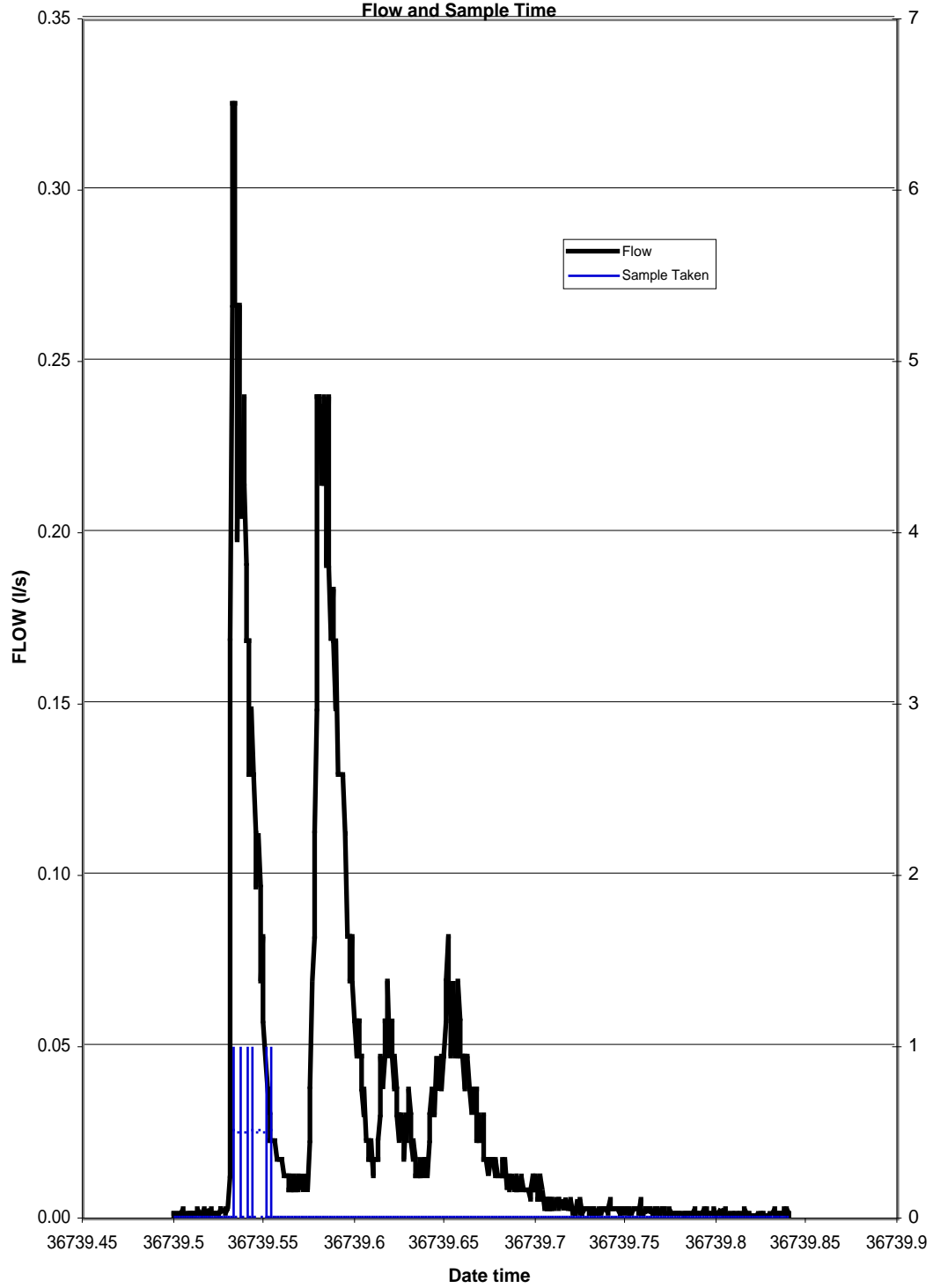
ENVIROPOD FILTER TRIAL - WAIRAU ROAD NORTH SHORE CITY
Monitored Storm Event # 5
Flow and Sample Time



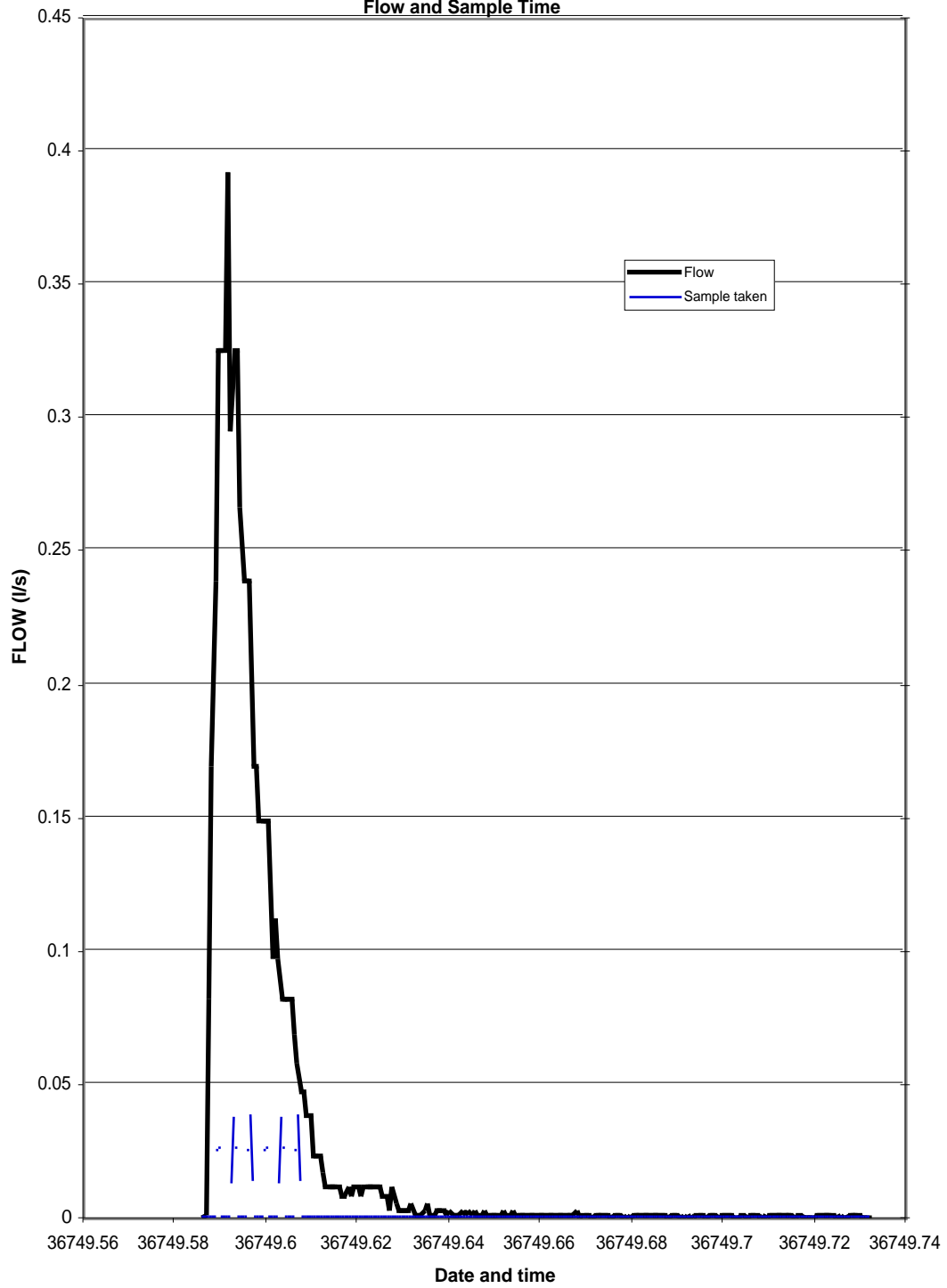
ENVIROPOD FILTER TRIAL - WAIRAU ROAD NORTH SHORE CITY
Monitored Storm Event #6
Flow and Sample Time



ENVIROPOD FILTER TRIAL - WAIRAU ROAD NORTH SHORE CITY
Monitored Storm Event # 7
Flow and Sample Time



ENVIROPOD FILTER TRIAL - WAIRAU ROAD NORTH SHORE CITY
Monitored Storm Event # 8
Flow and Sample Time



APPENDIX E

CALCULATIONS

**ENVIROPOD FILTER TRIAL - WAIRAU ROAD NORTH SHORE CITY
WAIRAU STORM # 1
CALCULATION TABLE**

| Constant | Value | Units |
|----------------|-------|----------------|
| Catchment Area | 774.4 | m ² |
| Runoff K | 0.85 | |

| Date Time | Level | Flow l/m | Flow l/s | Flow Cumul. | Part Flow | Upstream Sample Number | Upstream Concentration mg/l | Upstream Average Load | Downstream Test number | Downstream Concentration mg/l | Downstream Average Load |
|--------------------|-------|-------------|-------------|----------------|--------------|------------------------------|-----------------------------------|-----------------------------|------------------------------|-------------------------------------|-------------------------------|
| 30-Jan-00 08:25:00 | 0.136 | 0.006 | 0.00 | 0.0 | | Start | 0.0 | | | 0.0 | |
| 30-Jan-00 08:55:00 | 3.692 | 21.864 | 0.36 | 149.9 | 149.9 | A1 | 87.5 | 6559.4 | B7 | 44.5 | 3335.9 |
| 30-Jan-00 09:00:00 | 3.450 | 18.295 | 0.30 | 258.3 | 108.4 | A2 | 68.0 | 8424.2 | B1 | 20.0 | 3494.3 |
| 30-Jan-00 09:05:00 | 2.941 | 12.276 | 0.20 | 328.0 | 67.7 | A3 | 68.5 | 4652.8 | B2 | 17.0 | 1252.0 |
| 30-Jan-00 09:10:00 | 2.212 | 6.025 | 0.10 | 369.5 | 43.5 | A4 | 71.5 | 3069.6 | B3 | 13.5 | 664.0 |
| 30-Jan-00 09:15:00 | 1.732 | 3.266 | 0.05 | 389.1 | 19.6 | A5 | 63.0 | 1319.2 | B4 | 15.0 | 279.5 |
| 30-Jan-00 09:20:00 | 1.309 | 1.624 | 0.03 | 399.4 | 10.3 | A6 | 60.0 | 694.9 | B5 | 12.0 | 139.4 |
| 30-Jan-00 09:25:00 | 1.382 | 1.791 | 0.03 | 408.5 | 9.0 | A7 | 60.5 | 498.4 | B6 | 13.0 | 112.8 |
| 30-Jan-00 13:07:00 | 0.272 | 0.032 | 0.00 | 1045.0 | 636.5 | End | 0.0 | 16072.7 | | 0.0 | 4137.5 |
| Total | | | | 1045.0 | | | | 41231.3 | | | 13416.4185 |

| EVENT VOLUME TESTED | | | | SUSPENDED SOLID DATA | | | |
|-----------------------|-------|-------|--|-------------------------------|------|------|--|
| RAINFALL DATA | | | | Upstream Concentration mg/l | | | |
| Total storm rainfall: | 1.59 | mm | | Downstream Concentration mg/l | | | |
| Storm duration: | 0.194 | Days | | | | | |
| Storm duration: | 4.65 | hours | | | | | |
| Storm ave intensity: | 0.341 | mm/hr | | | | | |
| 6 min Duration Int. | 1.980 | mm/hr | | | | | |
| | | | | Average | 67.1 | 19.3 | |
| | | | | Median | 68.0 | 15.0 | |
| | | | | Max | 87.5 | 44.5 | |
| | | | | Min | 50.5 | 12.0 | |
| | | | | EMC | 35.5 | 12.8 | |
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**ENVIROPOD FILTER TRIAL - WAIRAU ROAD NORTH SHORE CITY
WAIRAU STORM # 2
CALCULATION TABLE**

| Constant | Value | Units |
|----------------|-------|----------------|
| Catchment Area | 774.4 | m ² |
| Runoff K | 0.85 | - |

| Date Time | Level | Flow | Flow | Flow | Part | Upstream | Upstream | Upstream | Downstream | Downst. | Downst. |
|--------------------|--------|--------|---------|--------|-------|----------|---------------|----------|------------|---------------|-----------|
| | cm | l/m | l/s | l | Flow | Sample | Concentration | Average | Test | Concentration | Average |
| | | | | | | Number | mg/l | Load | number | mg/l | Load |
| | | | | | | | | mg | | | mg |
| 11-Mar-00 21:15:00 | -1.498 | 0 | 0 | 0.0 | | Start | - | - | Start | - | - |
| 12-Mar-00 00:21:00 | 3.649 | 21.057 | 0.35095 | 340.1 | 340.1 | A1 | 376.0 | 25152.71 | B1 | 16.0 | 1070.33 |
| 12-Mar-00 00:26:00 | 4.094 | 28.063 | 0.46772 | 473.9 | 133.8 | A2 | 295.0 | 55374.60 | B2 | 14.0 | 2627.95 |
| 12-Mar-00 00:31:00 | 4.902 | 44.036 | 0.73393 | 715.5 | 241.6 | A3 | 206.0 | 40090.28 | B3 | 13.0 | 2529.97 |
| 12-Mar-00 00:36:00 | 3.682 | 21.535 | 0.35692 | 863.1 | 147.6 | A4 | 114.0 | 14481.76 | B4 | 16.0 | 2032.53 |
| 12-Mar-00 00:41:00 | 3.632 | 20.812 | 0.34887 | 989.6 | 106.5 | A5 | 134.0 | 13946.32 | B5 | 10.0 | 1040.77 |
| 12-Mar-00 00:46:00 | 3.51 | 19.109 | 0.31848 | 1071.3 | 101.7 | A6 | 73.0 | 6437.65 | B6 | 0.4 | 35.27 |
| 12-Mar-00 00:51:00 | 3.155 | 14.635 | 0.24392 | 1146.0 | 74.7 | A7 | 51.0 | 7091.35 | B7 | 0.1 | 13.90 |
| 12-Mar-00 01:06:00 | 2.658 | 9.537 | 0.15895 | 1349.4 | 203.4 | A8 | 43.0 | 1904.60 | B8 | 0.1 | 3.73 |
| 12-Mar-00 06:24:00 | 0.406 | 0.09 | 0.00 | 2187.9 | 838.6 | End | - | - | End | - | - |
| | | | | | | | | 164479.3 | | | 9354.4659 |

EVENT VOLUME TESTED

1009.3

RAINFALL DATA

| | | |
|-----------------------|-------|-------|
| Total storm rainfall: | 3.32 | mm |
| Storm duration: | 0.381 | days |
| Storm duration: | 9.150 | Hours |
| Storm ave intensity: | 0.363 | mm/hr |
| 6 min duration Int. | 4.300 | mm/hr |

SUSPENDED SOLID DATA

| | Upstream | Downst. |
|---------|---------------|---------------|
| | Concentration | Concentration |
| | mg/l | mg/l |
| Average | 161.5 | 8.7 |
| Median | 124.0 | 11.5 |
| Max | 376.0 | 16.0 |
| Min | 43.0 | 0.1 |
| EMC | 163.0 | 9.3 |

Return period

1 in 2 Weeks

SUSPEND SOLIDS REMOVAL RATE

94.31%

**ENVIROPOD FILTER TRIAL - WAIRAU ROAD NORTH SHORE CITY
WAIRAU STORM # 3
CALCULATION TABLE**

| Constant | | Value | Units |
|----------------|--|-------|-------|
| Catchment Area | | 774.4 | m2 |
| Runoff K | | 0.85 | - |

| Date Time | Level | Flow | Flow | Flow | Part | Upstream | Upstream | Upstream | Downstream | Downstream | Downstream |
|--------------------|-------|--------|------|---------------|--------|----------|---------------|-----------------|------------|---------------|-------------------|
| | cm | l/m | l/s | Cumul. | Flow | Sample | Concentration | Average | Test | Concentration | Average |
| | | | | | | Number | mg/l | Load | number | mg/l | Load |
| 09-Apr-00 00:01:00 | 0.003 | 0.153 | 0.00 | 0.0 | | Start | 0.0 | | | 0.0 | |
| 09-Apr-00 00:30:00 | 0.339 | 20.366 | 0.34 | 119.3 | 119.3 | A1 | 191.0 | 11389.00 | B1 | 11.0 | 655.91 |
| 09-Apr-00 00:35:00 | 0.262 | 15.729 | 0.26 | 222.5 | 103.2 | A2 | 240.0 | 22245.53 | B2 | 7.0 | 928.05 |
| 09-Apr-00 00:40:00 | 0.223 | 13.369 | 0.22 | 294.1 | 71.6 | A3 | 396.0 | 22775.16 | B3 | 6.0 | 465.53 |
| 09-Apr-00 00:45:00 | 0.148 | 8.891 | 0.15 | 344.1 | 49.9 | A4 | 84.0 | 11987.28 | B4 | 4.0 | 249.74 |
| 09-Apr-00 00:50:00 | 0.088 | 5.276 | 0.09 | 379.9 | 35.9 | A5 | 80.0 | 2943.43 | B5 | 7.0 | 197.43 |
| 09-Apr-00 00:55:00 | 0.080 | 4.804 | 0.08 | 403.3 | 23.4 | A6 | 73.0 | 1787.42 | B6 | 7.0 | 163.56 |
| 09-Apr-00 01:00:00 | 0.055 | 3.277 | 0.05 | 421.6 | 18.3 | A7 | 124.0 | 1797.97 | B7 | 8.0 | 136.90 |
| 09-Apr-00 23:35:00 | 0.000 | 0.022 | 0.00 | 1423.0 | 1001.4 | End | 0.0 | 62089.68 | - | 0.0 | 4005.79 |
| Total | | | | 1423.0 | | | | 137016.5 | | | 6803.89075 |

| EVENT VOLUME TESTED | | 302.3 |
|---------------------|--|-------|
|---------------------|--|-------|

| RAINFALL EVENT DATA | |
|-----------------------|-------------|
| Total storm rainfall: | 2.16 mm |
| Storm duration: | 0.98 hours |
| Storm duration: | 23.57 hours |
| Storm ave intensity: | 0.09 mm/hr |
| 6 min duration Int. | 1.84 mm/hr |

| SUSPENDED SOLID DATA | |
|--------------------------|-------|
| Upstream Concentration | mg/l |
| Average | 169.7 |
| Median | 124.0 |
| Max | 396.0 |
| Min | 73.0 |
| EMC | 96.3 |
| Downstream Concentration | mg/l |
| Average | 7.1 |
| Median | 7.0 |
| Max | 11.0 |
| Min | 4.0 |
| EMC | 4.8 |

| | | | |
|----------------------|--------------------|-------------------------------------|---------------|
| Return period | 1 in 1 week | SUSPENDED SOLID REMOVAL RATE | 95.03% |
|----------------------|--------------------|-------------------------------------|---------------|

**ENVIROPOD FILTER TRIAL - WAIRAU ROAD NORTH SHORE CITY
WAIRAU STORM # 4
Calculation tables**

| | | | |
|----------------|--|-------|-------|
| Constant | | Value | Units |
| Catchment Area | | 774.4 | m2 |
| Runoff K | | 0.85 | - |

| | | | | | | | | | | |
|--------------------|-------|--------|-------------|-----------|------------------------|---------------------|-----------------------|------------------------|-----------------------|-------------------------|
| Date Time | Level | Flow | Flow Cumul. | Part Flow | Upstream Sample Number | Upstream Concentric | Upstream Average Load | Downstream Test number | Downstream Concentric | Downstream Average Load |
| | cm | l/m | l/s | l | | mg/l | mg | | mg/l | mg |
| 07-May-00 12:29:00 | 0.545 | 0.181 | 0.00 | 0.0 | - | Start | 0.0 | - | 0.0 | 1549.37 |
| 07-May-00 12:33:00 | 3.565 | 19.870 | 0.33 | 67.4 | A1 | 207.5 | 6939.02 | B1 | 46.0 | 5201.45 |
| 07-May-00 12:38:00 | 4.173 | 29.452 | 0.49 | 208.3 | A2 | 102.5 | 21843.01 | B2 | 42.0 | 7143.55 |
| 07-May-00 12:43:00 | 5.085 | 47.797 | 0.80 | 397.5 | A3 | 106.5 | 19774.85 | B3 | 33.5 | 4638.00 |
| 07-May-00 12:48:00 | 4.391 | 33.443 | 0.56 | 583.1 | A4 | 82.5 | 17531.64 | B4 | 16.5 | 2513.65 |
| 07-May-00 12:53:00 | 4.152 | 29.069 | 0.48 | 730.9 | A5 | 53.5 | 10054.62 | B5 | 17.5 | 2895.98 |
| 07-May-00 12:58:00 | 4.240 | 30.645 | 0.51 | 865.4 | A6 | 25.5 | 9100.81 | B6 | 20.0 | 2841.44 |
| 07-May-00 13:03:00 | 4.280 | 31.370 | 0.52 | 1045.5 | A7 | 10.5 | 2851.57 | B7 | 13.0 | 9004.71 |
| 07-May-00 13:08:00 | 4.280 | 31.370 | 0.52 | 1045.5 | A8 | 10.5 | 0.00 | B8 | 9.5 | 0.00 |
| 07-May-00 13:13:00 | 4.881 | 43.799 | 0.73 | 2104.8 | A9 | 26.0 | 19333.65 | B9 | 7.5 | 13468.57 |
| 07-May-00 13:18:00 | 4.305 | 31.819 | 0.53 | 3084.4 | A10 | 6.0 | 15572.51 | B10 | 20.0 | 14037.89 |
| 07-May-00 13:23:00 | 1.834 | 2.825 | 0.05 | 4069.5 | A11 | 15.5 | 10586.99 | B11 | 8.5 | 9406.40 |
| 07-May-00 13:25:00 | 1.906 | 4.153 | 0.07 | 5095.1 | A12 | 12.5 | 13994.69 | B12 | 10.5 | 9232.19 |
| 07-May-00 09:48:00 | 0.408 | 0.068 | 0.00 | 6827.6 | End | 0.0 | 10890.70 | - | 0.0 | - |
| Total | | | | 6827.6 | | | 144769.4 | | | 73590.98 |

| | |
|---------------------|--------|
| EVENT VOLUME TESTED | |
| | 5001.7 |

| | |
|-----------------------|-------------|
| RAINFALL DATA | |
| Total storm rainfall: | 10.37 mm |
| Storm duration: | 1.869 Days |
| Storm duration: | 45.33 hours |
| Storm ave intensity | 0.229 mm/hr |
| 6 min duration Int. | 4.710 mm/hr |

| | |
|------------------------|-------|
| SUSPENDED SOLID DATA | |
| Upstream Concentration | mg/l |
| Downst. Concentration | mg/l |
| Average | 54.9 |
| Median | 25.8 |
| Max | 207.5 |
| Min | 6.0 |
| EMC | 21.2 |

| | |
|------------------------------|--------------|
| Return period | 1 in 1 month |
| SUSPENDED SOLID REMOVAL RATE | 49.17% |

| Constant | Value | Units |
|----------------|-------|----------------|
| Catchment Area | 774.4 | m ² |
| Runoff K | 0.85 | - |

| EVENT VOLUME TESTED | | 120011.0 | |
|-------------------------------|------------------------|----------|--------|
| RAINFALL DATA | | | |
| Total storm rainfall: | 18.49 | mm | |
| Storm duration: | 0.492 | Days | |
| Storm duration: | 11.82 | hours | |
| Storm ave intensity: | 1.585 | mm/hr | |
| 6 min Duration Int. | 7.210 | mm/hr | |
| SUSPENDED SOLID DATA | | | |
| | Upstream Concentration | mg/l | |
| | Average | 34.1 | |
| | Median | 25.5 | |
| | Max | 99.5 | |
| | Min | 2.0 | |
| | EMC | 21.9 | |
| Downstream Concentration mg/l | | | |
| | 7.1 | | |
| | 4.0 | | |
| | 34.5 | | |
| | 0.5 | | |
| | 4.6 | | |
| SUSPENDED SOLID REMOVAL RATE | | | |
| Return period | 1 in 1 | Month | 79.18% |

**ENVIROPOD FILTER TRIAL - WAIRAU ROAD NORTH SHORE CITY
WAIRAU STORM # 6
CALCULATION TABLE**

| Constant | Value | Units |
|----------------|-------|----------------|
| Catchment Area | 774.4 | m ² |
| Runoff K | 0.85 | - |

| Date Time | Level | Flow | Flow | Flow | Part | Upstream Sample Number | Upstream Concentration | Upstream Average Load | Downstream Test number | Downstream Concentration | Downstream Average Load |
|--------------------|-------|--------|------|--------|--------|------------------------|------------------------|-----------------------|------------------------|--------------------------|-------------------------|
| | cm | l/m | l/s | l | l | | mg/l | mg | | mg/l | mg |
| 28-Jul-00 02:10:00 | 0.136 | 0.006 | 0.00 | 0.0 | 0.0 | Start | 0.0 | - | | 0.0 | - |
| 28-Jul-00 04:16:00 | 3.813 | 23.491 | 0.39 | 376.8 | 376.8 | A1 | 180.0 | 33910.38 | B1 | 45.0 | 8477.60 |
| 28-Jul-00 04:21:00 | 4.221 | 30.298 | 0.50 | 571.6 | 948.8 | A2 | 196.0 | 36626.16 | B2 | 16.0 | 5942.01 |
| 28-Jul-00 04:26:00 | 3.469 | 13.555 | 0.37 | 700.5 | 126.9 | A3 | 133.0 | 21201.25 | B3 | 1.0 | 1095.51 |
| 28-Jul-00 04:31:00 | 3.132 | 14.366 | 0.24 | 791.3 | 90.8 | A4 | 92.0 | 10218.26 | B4 | 3.0 | 181.66 |
| 28-Jul-00 04:36:00 | 2.723 | 10.129 | 0.17 | 849.0 | 57.7 | A5 | 109.0 | 5800.46 | B5 | 4.0 | 202.01 |
| 28-Jul-00 04:41:00 | 2.587 | 8.910 | 0.15 | 895.6 | 46.6 | A6 | 113.0 | 5168.72 | B6 | 4.0 | 186.26 |
| 28-Jul-00 04:46:00 | 3.132 | 14.366 | 0.24 | 948.0 | 52.4 | A7 | 65.0 | 4687.07 | B7 | 2.0 | 157.32 |
| 28-Jul-00 05:18:00 | 2.996 | 12.855 | 0.21 | 1378.9 | 431.9 | A8 | 50.0 | 24831.89 | B8 | 4.0 | 1295.58 |
| 28-Jul-00 07:57:00 | 1.906 | 4.153 | 0.07 | 2376.7 | 996.8 | A9 | 57.0 | 53330.99 | B9 | 11.0 | 7476.31 |
| 28-Jul-00 11:35:00 | 2.451 | 7.784 | 0.13 | 3379.1 | 1002.4 | A10 | 68.0 | 82647.56 | B10 | 13.0 | 12028.33 |
| 28-Jul-00 14:55:00 | 2.179 | 5.798 | 0.10 | 4380.6 | 1001.5 | A11 | 45.0 | 56587.57 | B11 | 6.0 | 9514.72 |
| 28-Jul-00 08:49:00 | 0.136 | 0.006 | 0.00 | 5542.0 | 1161.3 | End | 0.0 | 26130.15 | | 0.0 | 3484.02 |
| | | | | 5542.0 | | | | 341120.5 | | | 50041 |

| EVENT VOLUME TESTED | | SUSPENDED SOLID DATA | |
|---------------------|--------|------------------------|--------------------------|
| | 4003.9 | Upstream Concentration | Downstream Concentration |
| | | mg/l | mg/l |
| | | Average | Average |
| | | Median | Median |
| | | Max | Max |
| | | Min | Min |
| | | EMC | EMC |
| | | 81.6 | 9.0 |
| | | | 85.33% |

| RAINFALL DATA | |
|-----------------------|-------------|
| Total storm rainfall: | 8.42 mm |
| Storm duration: | 1.194 Days |
| Storm duration: | 28.65 hours |
| Storm ave intensity: | 0.294 mm/hr |
| 6 min duration Int: | 3.420 mm/hr |

| | |
|---------------|------------------------------|
| Return period | 1 in 3 weeks |
| | SUSPENDED SOLID REMOVAL RATE |
| | 85.33% |

**ENVIROPOD FILTER TRIAL - WAIRAU ROAD NORTH SHORE CITY
WAIRAU STORM # 7
CALCULATION TABLE**

| Constant | Value | Units |
|----------------|-------|----------------|
| Catchment Area | 774.4 | m ² |
| Runoff K | 0.85 | - |

| Date Time | Level | Flow | Flow Cumul. | Part Flow | Upstream Sample Number | Upstream Concentration | Upstream Average Load | Downstream Test number | Downstream Concentration | Downstream Average Load |
|--------------------|-------|--------|-------------|-----------|------------------------|------------------------|-----------------------|------------------------|--------------------------|-------------------------|
| | cm | l/s | l | l | | mg/l | mg | | mg/l | mg |
| 01-Aug-00 12:00:00 | 0.272 | 0.032 | 0.00 | 0.0 | Start | 0.0 | | | 0.0 | |
| 01-Aug-00 12:48:00 | 3.540 | 19.518 | 0.33 | 50.6 | A1 | 273.0 | 6307.04 | B1 | 12.0 | 303.61 |
| 01-Aug-00 12:53:00 | 3.268 | 15.978 | 0.27 | 129.9 | A2 | 218.0 | 19472.81 | B2 | 16.0 | 1110.47 |
| 01-Aug-00 12:58:00 | 2.859 | 11.443 | 0.19 | 194.5 | A3 | 196.0 | 13371.99 | B3 | 15.0 | 1001.28 |
| 01-Aug-00 13:03:00 | 2.587 | 8.910 | 0.15 | 239.3 | A4 | 160.0 | 7963.01 | B4 | 20.0 | 782.88 |
| 01-Aug-00 13:08:00 | 2.315 | 6.747 | 0.11 | 274.1 | A5 | 142.0 | 5263.86 | B5 | 14.0 | 592.62 |
| 01-Aug-00 13:13:00 | 1.634 | 2.825 | 0.05 | 295.3 | A6 | 142.0 | 3004.72 | B6 | 18.0 | 338.56 |
| 01-Aug-00 13:18:00 | 1.225 | 1.376 | 0.02 | 305.8 | A7 | 120.0 | 1380.22 | B7 | 15.0 | 173.84 |
| 01-Aug-00 20:11:00 | 0.136 | 0.003 | 0.00 | 923.3 | | 0.0 | 37049.64 | | 0.0 | 4631.21 |
| | | | | 923.3 | | | 94413.3 | | | 8934.5 |

EVENT VOLUME TESTED

255.2

RAINFALL DATA

| | | |
|-----------------------|-------|-------|
| Total storm rainfall: | 1.40 | mm |
| Storm duration: | 0.341 | Days |
| Storm duration: | 8.18 | hours |
| Storm ave intensity: | 0.171 | mm/hr |
| 6 min duration Int | 1.500 | mm/hr |

SUSPENDED SOLID DATA

| Upstream Concentration | Downstream Concentration |
|------------------------|--------------------------|
| mg/l | mg/l |
| Average | 15.7 |
| Median | 15.0 |
| Max | 20.0 |
| Min | 12.0 |
| EMC | 9.7 |

Return period

1 in 1 week

SUSPENDED SOLID REMOVAL RATE

90.54%

**ENVIROPOD FILTER TRIAL - WAIRAU ROAD NORTH SHORE CITY
WAIRAU STORM # 8
CALCULATION TABLE**

| Constant | Value | Units |
|----------------|-------|-------|
| Catchment Area | 774.4 | m2 |
| Runoff K | 0.85 | |

| Date Time | Level | Flow l/m | Flow l/s | Flow Cumul. l | Part Flow l | Upstream Sample Number | Upstream Concentration mg/l | Upstream Average Load mg | Downstream Test number | Downst. Concentration mg/l | Downst. Average Load mg |
|--------------------|--------|-------------|-------------|---------------------|-------------------|------------------------------|-----------------------------------|-----------------------------------|------------------------------|----------------------------------|----------------------------------|
| 11-Aug-00 14:04:00 | -0.408 | 0.00 | 0.00 | 0.0 | 0.0 | Start | 0.0 | - | | 0.0 | - |
| 11-Aug-00 14:06:00 | 3.540 | 19.52 | 0.33 | 49.0 | 49.0 | A1 | 333.0 | 8164.33 | B1 | 84.0 | 2059.47 |
| 11-Aug-00 14:14:00 | 3.540 | 19.52 | 0.33 | 148.8 | 99.7 | A2 | 132.0 | 23189.55 | B2 | 73.0 | 7829.59 |
| 11-Aug-00 14:19:00 | 3.132 | 14.37 | 0.24 | 227.4 | 78.6 | A3 | 93.0 | 8841.83 | B3 | 65.0 | 5422.99 |
| 11-Aug-00 14:24:00 | 2.587 | 8.91 | 0.15 | 274.4 | 47.0 | A4 | 69.0 | 3808.03 | B4 | 24.0 | 2090.97 |
| 11-Aug-00 14:29:00 | 2.042 | 4.93 | 0.08 | 306.5 | 32.2 | A5 | 60.0 | 2076.06 | B5 | 37.0 | 981.70 |
| 11-Aug-00 14:34:00 | 1.770 | 3.45 | 0.06 | 328.9 | 22.4 | A6 | 79.0 | 1557.15 | B6 | 20.0 | 638.54 |
| 11-Aug-00 17:34:00 | 0.000 | 0.00 | 0.00 | 367.7 | 38.8 | End | 0.0 | 1531.30 | | 0.0 | 367.67 |
| | | | | 367.7 | | | | 47634.9 | | | 19023.3 |

| RAINFALL DATA | | VOLUME TESTED | |
|-----------------------|-------------|---------------|-------|
| Total storm rainfall: | 0.56 mm | | 279.9 |
| Storm duration: | 0.146 Days | | |
| Storm duration: | 3.50 hours | | |
| Storm ave intensity: | 0.160 mm/hr | | |
| 6 min duration Int | 1.810 mm/hr | | |

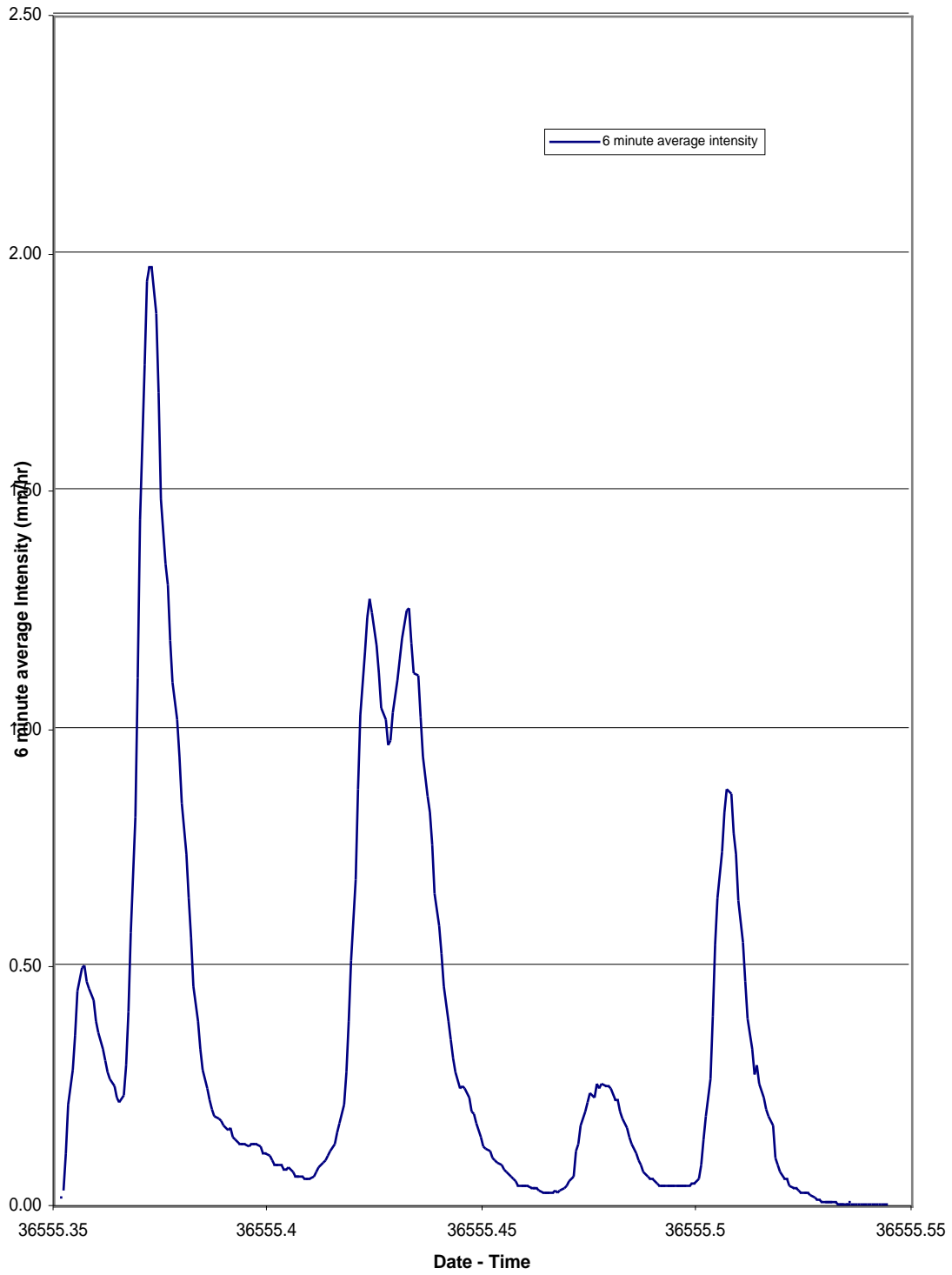
| SUSPENDED SOLID DATA | |
|-----------------------------------|-------|
| Upstream Concentration mg/l | 127.7 |
| Average | 127.7 |
| Median | 86.0 |
| Max | 333.0 |
| Min | 60.0 |
| EMC | 129.5 |
| Downst. Concentration mg/l | 50.5 |
| | 51.0 |
| | 84.0 |
| | 20.0 |
| | 51.7 |

| | | | |
|---------------|-------------|------------------------------|--------|
| Return period | 1 in 1 week | SUSPENDED SOLID REMOVAL RATE | 60.06% |
|---------------|-------------|------------------------------|--------|

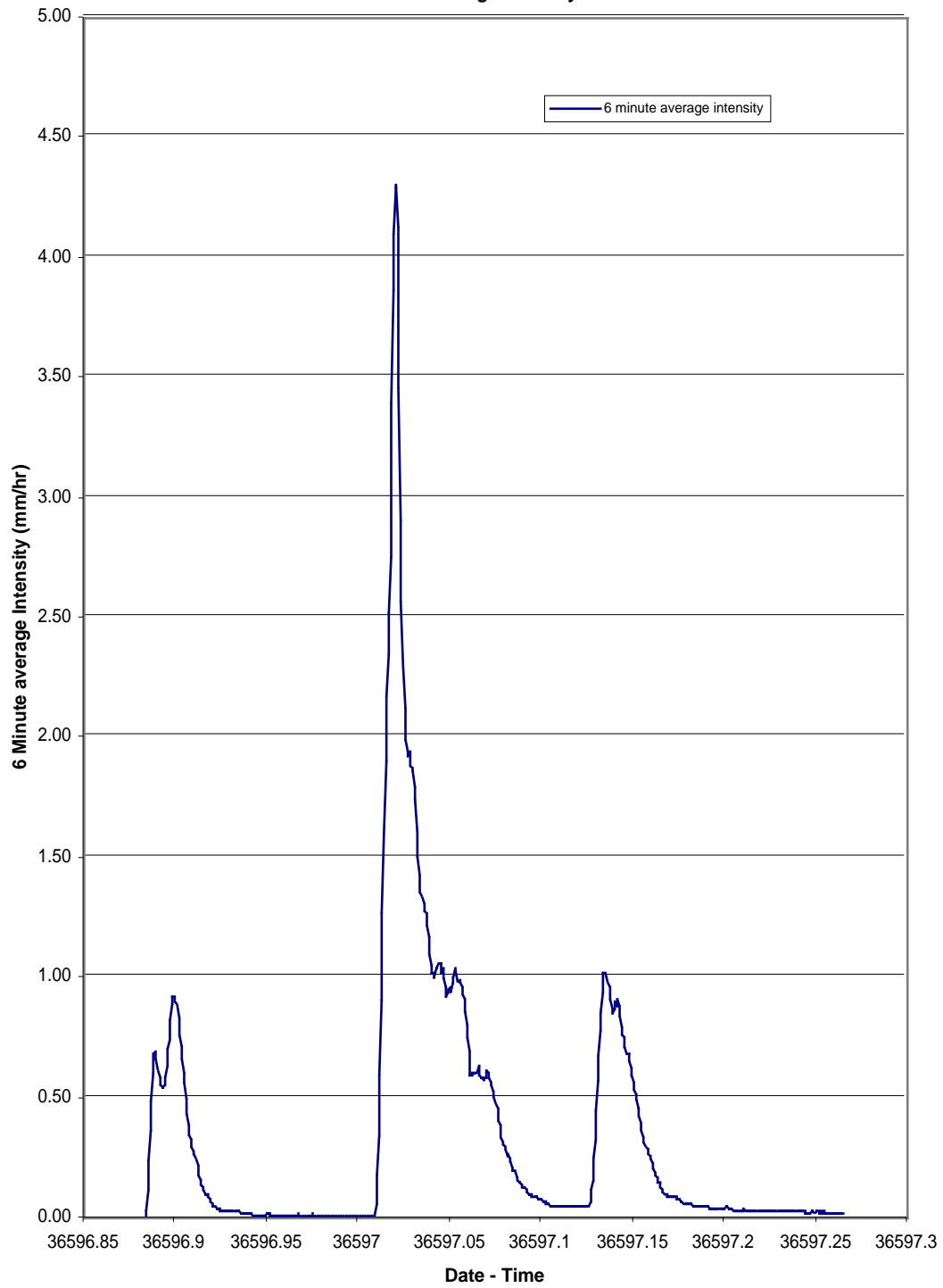
APPENDIX F

6 MINUTE INTENSITY GRAPHS

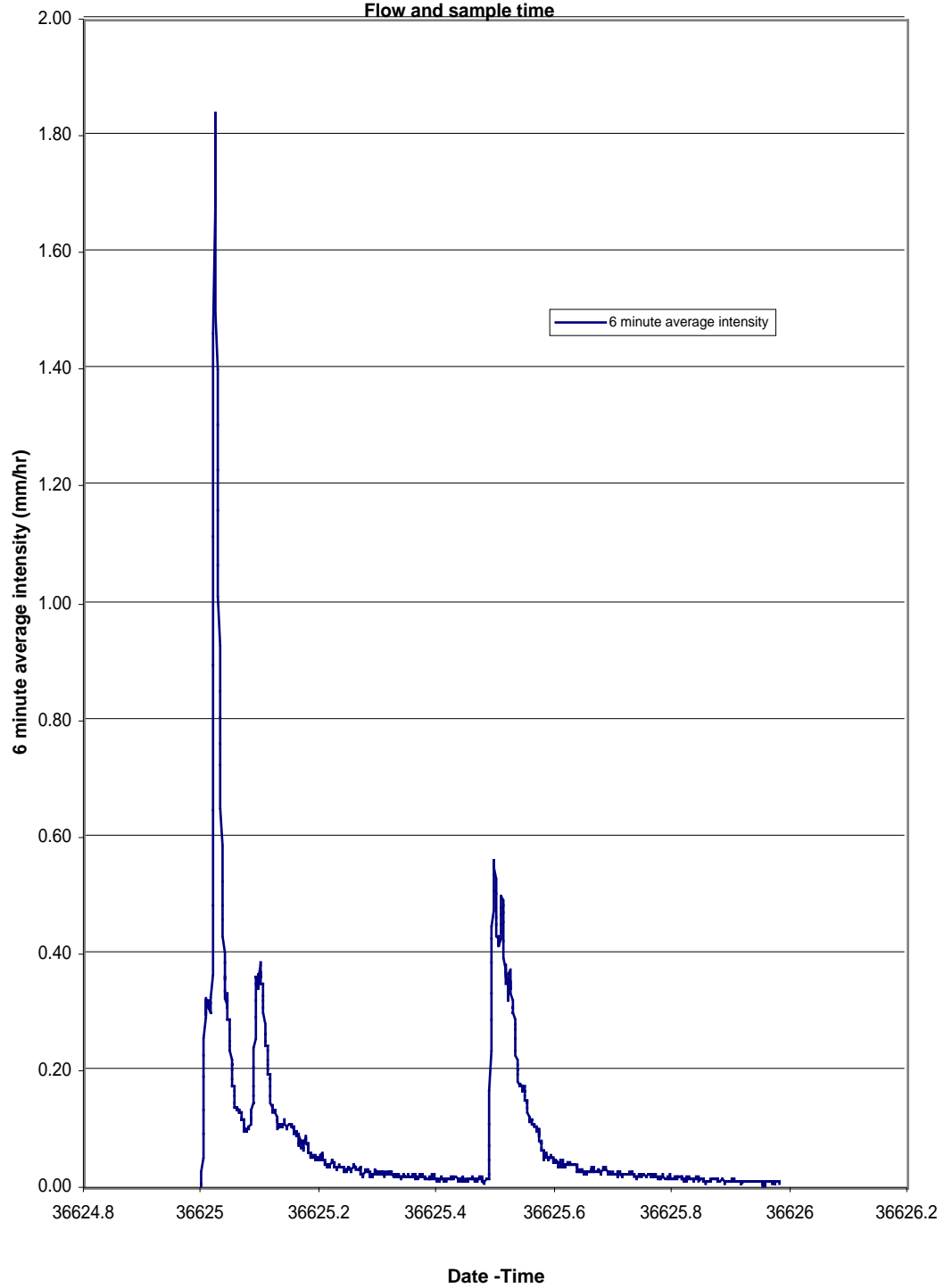
ENVIROPOD FILTER TRIAL - WAIRAU ROAD NORTH SHORE CITY
Monitored storm event #1
6 Minute average intensity



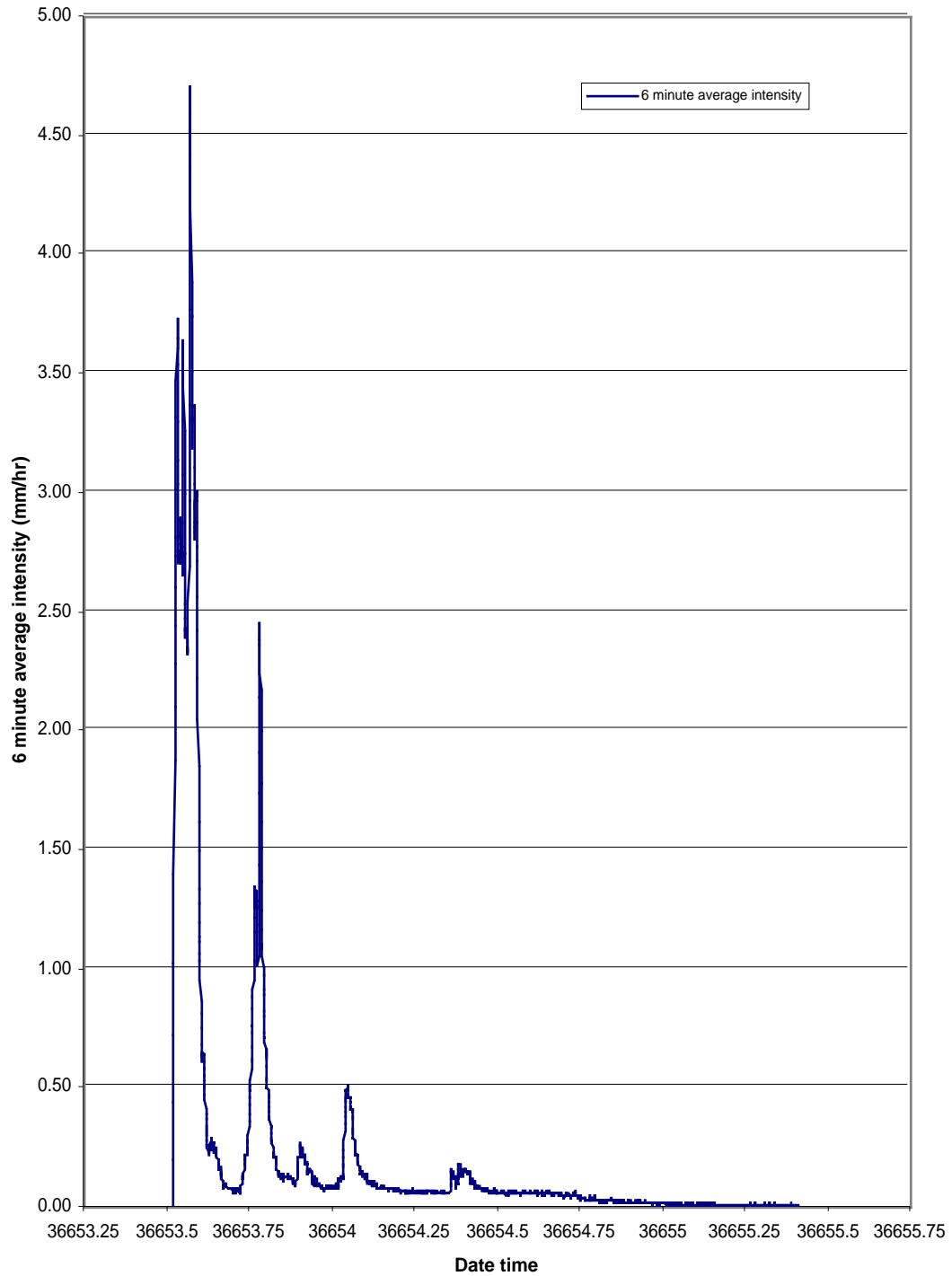
ENVIROPOD FILTER TRIAL - WAIRAU ROAD NORTH SHORE CITY
Monitored storm event # 2
6 minute average intensity



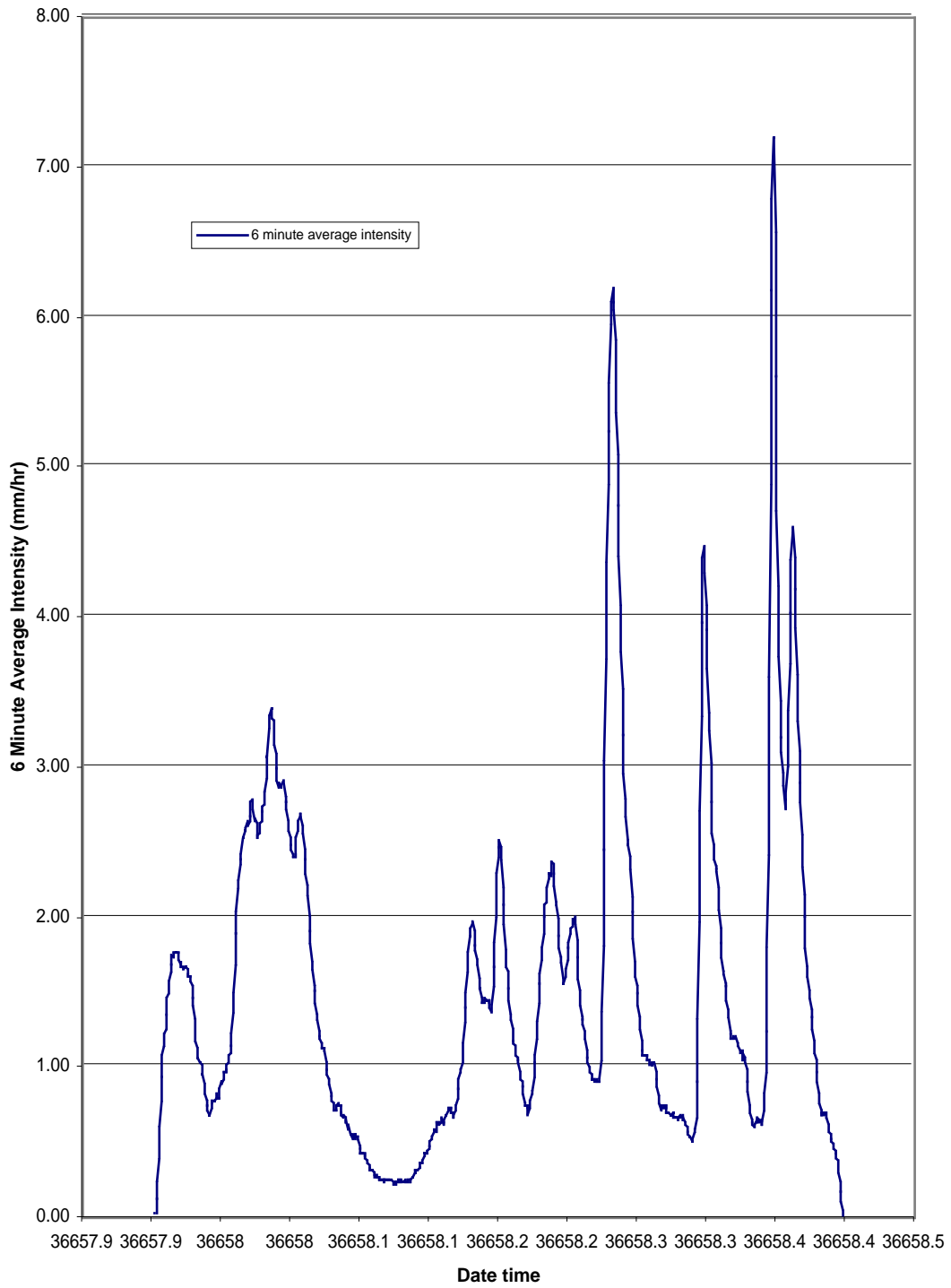
ENVIROPOD FILTER TRIAL - WAIRAU ROAD NORTH SHORE CITY
Monitored Storm Event # 3
Flow and sample time



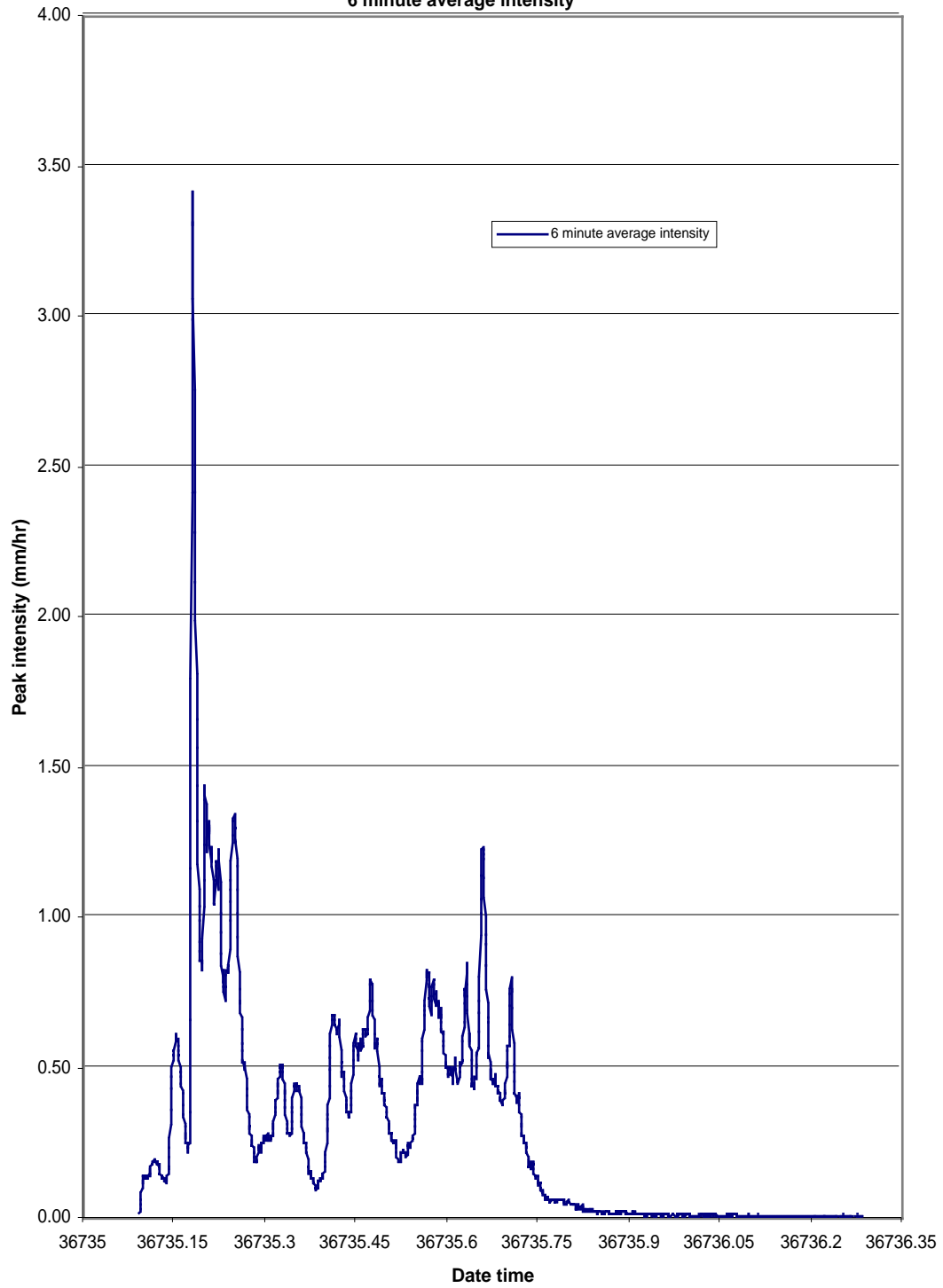
ENVIROPOD FILTER TRIAL - WAIRAU ROAD NORTH SHORE CITY
Monitored storm event #4
6 minute average intensity



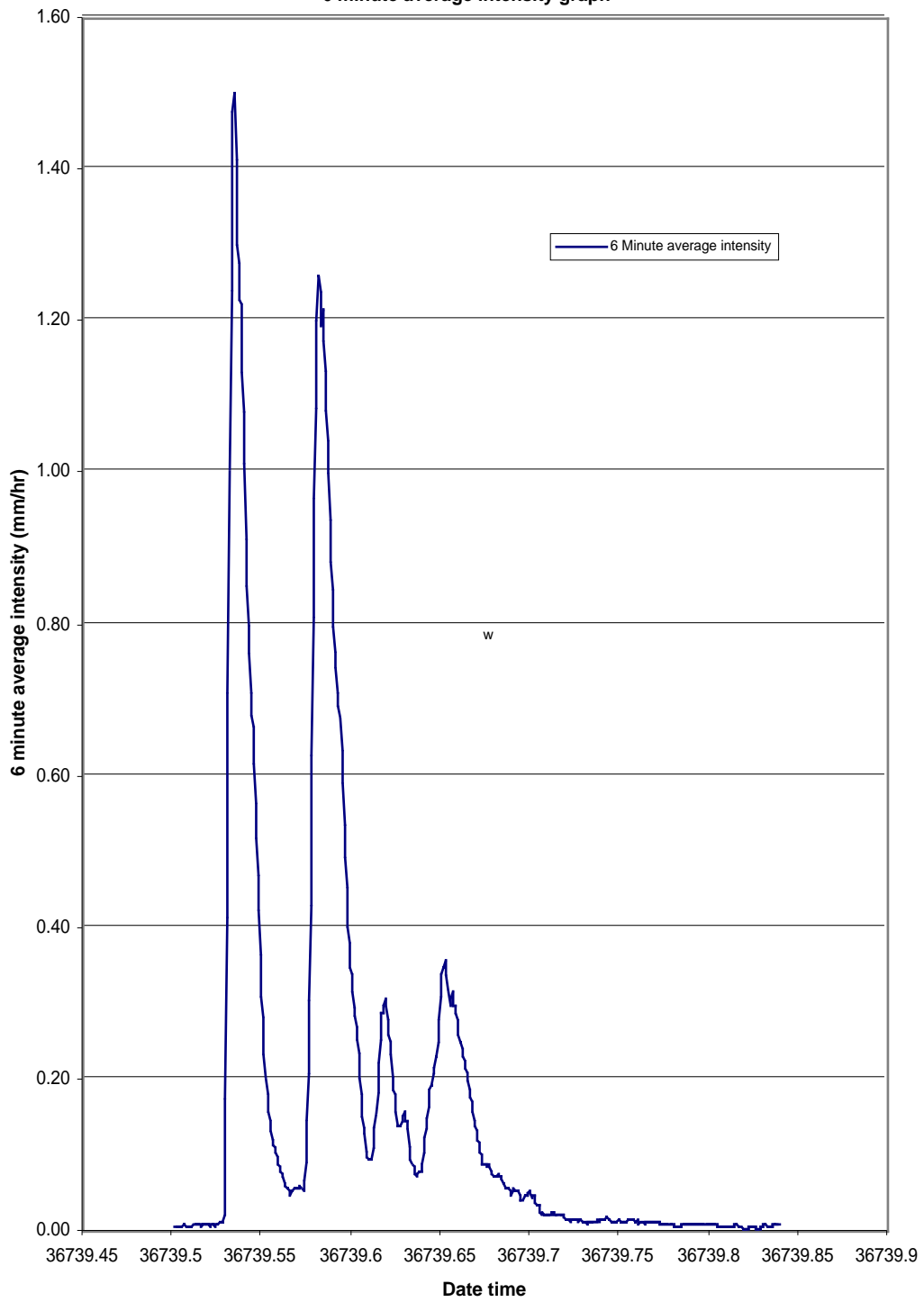
ENVIROPOD FILTER TRIAL - WAIRAU ROAD NORTH SHORE CITY
MONITORED STORM EVENT # 5
6 minute average intensity



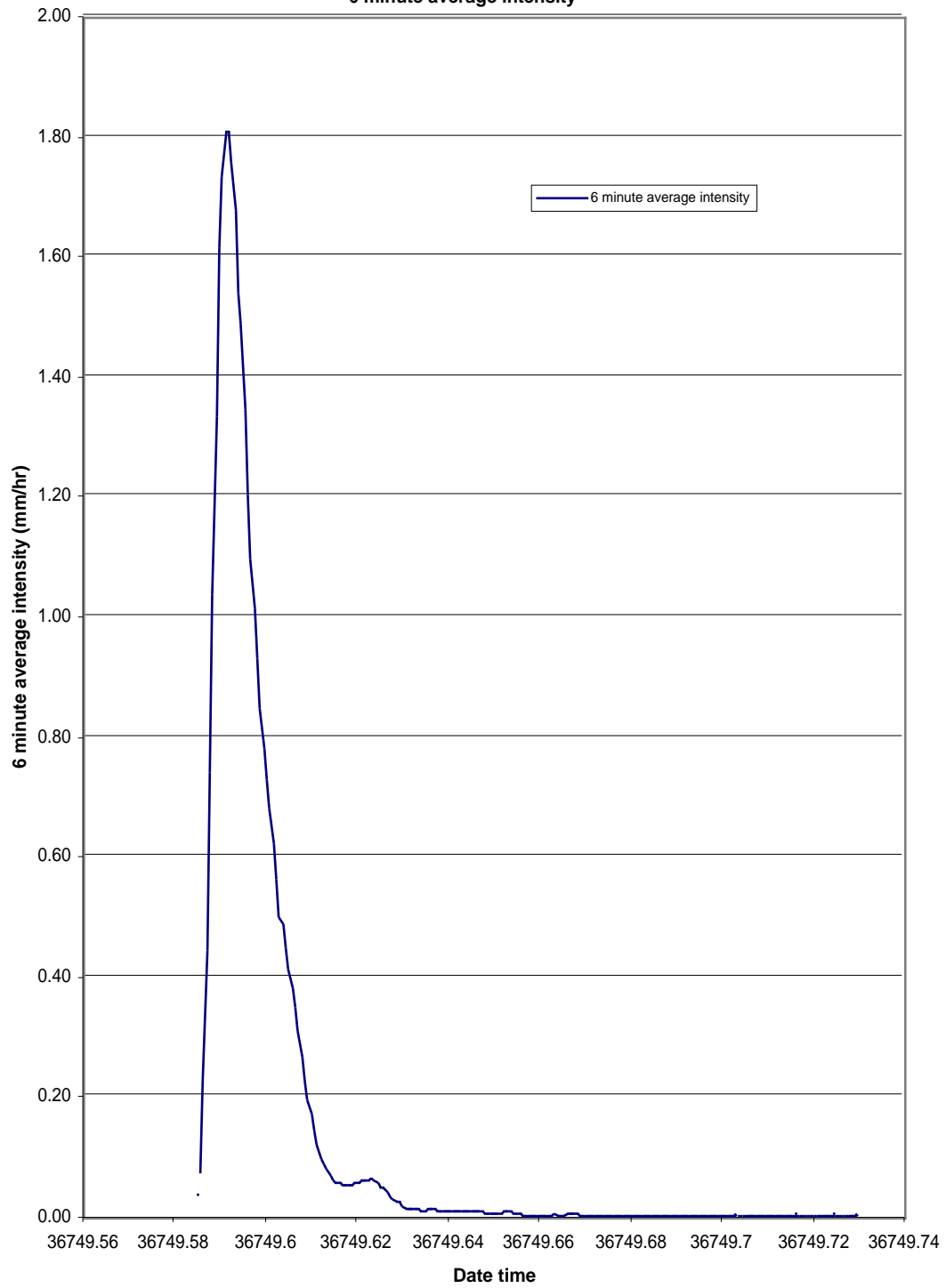
ENVIROPOD FILTER TRIAL - WAIRAU ROAD NORTH SHORE CITY
Monitored storm event # 6
6 minute average intensity



ENVIROPOD FILTER TRIAL - WAIRAU ROAD NORTH SHORE CITY
Monitored storm event # 7
6 minute average intensity graph



ENVIROPOD FILTER TRIAL - WAIRAU ROAD NORTH SHORE CITY
Monitored storm event # 8
6 minute average intensity



APPENDIX G

SUMMARY AND CALCULATIONS OF RETAINED LOADS

| | | |
|---|----------------------------------|--------------------------------|
| Constant | Value | Units |
| Area | 774.4 | m2 |
| Runoff K | 0.85 | - |
| Rain(total) | 748.2 | mm |
| | | |
| Date | Installed Duration Days | retained Load kg/ha/year |
| Installation | 16-Jan-00 | |
| First Empty | 120 days | |
| Final Empty | 15-May-00 93 days | |
| Total | 16-Aug-00 213 days | |
| | | |
| Estimated Suspended solids load from Catchment | | |
| Rainfall over catchment (during study) | 728 mm | |
| Calculated Runoff from Catchment | 492.5 m3 | |
| Average EMC Upstream | 72.2 mg/l | |
| | | |
| Estimated Suspended solids load during study (Dry Weight) | | |
| Estimate SS Load | 35.6 kg 785.8 kg/hectare/year | |
| | | |
| Estimated Loading in kg/ha/mm | | |
| Ave EMC Inlet | 72.2 mg/l | |
| 1mm runoff over 1 ha | 8.5 m3 | |
| loading | 0.61 kg/ha/mm | |

RemovalLoads

APPENDIX H

CALIBRATION DATA

ENVIROPOD FILTER TRIAL WAIRAU ROAD NORTH SHORE CITY CALIBRATION DATA

Test by: Mike Hannah
Test Date: 17-Jan-00

Test Number: 1

| | Depth 1 | Depth 2 | Depth 3 |
|------------|---------|---------|---------|
| | (mm) | (mm) | (mm) |
| Measured | 76 | 75 | 78 |
| Logged | 77 | 76 | 78 |
| Difference | 1 | 1 | 0 |

Test Number: 2

| | Depth 1 |
|------------|---------|
| | (mm) |
| Measured | 98 |
| Logged | 98 |
| Difference | 0 |

Test Number: 3

| | Depth 1 | Depth 2 | Depth 3 |
|------------|---------|---------|---------|
| | (mm) | (mm) | (mm) |
| Measured | 60 | 60 | 61 |
| Logged | 60 | 60 | 60 |
| Difference | 0 | 0 | 1 |

ENVIROPOD FILTER TRIAL WAIRAU ROAD NORTH SHORE CITY CALIBRATION DATA

Test by: Mike Hannah
Test Date: 14-Apr-00

Test Number: 4

| | |
|------------|---------|
| | Depth 1 |
| | (mm) |
| Measured | 0 |
| Logged | 0 |
| Difference | 0 |

APPENDIX I

RAINFALL DEPTHS

Enviropod Filter Trial
Wairau Road North Shore City
Comparison Between Logged flows and Rain gauge Data

| Storm | Logged flow at test site | Depth | Rain Gauge | Depth | % Difference |
|-------|--------------------------|-------|------------|-------|--------------|
| | (l) | (mm) | | (mm) | |
| WS1 | 1045.0 | 1.6 | | 3.9 | 59% |
| WS2 | 2187.9 | 3.3 | | 11.9 | 72% |
| WS3 | 1423.0 | 2.2 | | 5.0 | 57% |
| WS4 | 6827.6 | 10.4 | | 17.9 | 42% |
| WS5 | 12169.7 | 18.5 | | 26.3 | 30% |
| WS6 | 5542.0 | 8.4 | | 17.8 | 53% |
| WS7 | 923.3 | 1.4 | | 1.3 | -8% |
| WS8 | 367.7 | 0.6 | | 2.2 | 75% |
| Total | 30486.2 | 46.3 | | 86.3 | 46% |

APPENDIX J

LABORATORY DATA

**ENVIROPOD FILTER TRIAL
WAIRAU ROAD - NORTH SHORE CITY COUNCIL
LABORATORY RESULTS SUMMARY TABLE**

Compiled by: Matthew Musson
Date: 18-Jan-01

| Date - Time | Storm Number | UPSTREAM | | | DOWNSTREAM | | |
|------------------------|--------------|--------------|---------------|--|--------------|---------------|--|
| | | Field Number | Sample Number | Laboratory Number Concentration mg/l | Field Number | Sample Number | Laboratory Number Concentration mg/l |
| 30-Jan-00 08:55:00 WS1 | | | A1 | 2000 87.5 | | B7 | 2014 44.5 |
| 30-Jan-00 09:00:00 WS1 | | | A2 | 2001 68.0 | | B1 | 2008 20.0 |
| 30-Jan-00 09:05:00 WS1 | | | A3 | 2002 69.5 | | B2 | 2009 17.0 |
| 30-Jan-00 09:10:00 WS1 | | | A4 | 2003 71.5 | | B3 | 2010 13.5 |
| 30-Jan-00 09:15:00 WS1 | | | A5 | 2004 63.0 | | B4 | 2011 15.0 |
| 30-Jan-00 09:20:00 WS1 | | | A6 | 2005 60.0 | | B5 | 2012 12.0 |
| 30-Jan-00 09:25:00 WS1 | | | A7 | 2006 50.5 | | B6 | 2013 13.0 |
| 12-Mar-00 00:21:00 WS2 | | | A1 | 2415 376.0 | | B1 | 2423 16.0 |
| 12-Mar-00 00:26:00 WS2 | | | A2 | 2416 295.0 | | B2 | 2424 14.0 |
| 12-Mar-00 00:31:00 WS2 | | | A3 | 2417 206.0 | | B3 | 2425 13.0 |
| 12-Mar-00 00:36:00 WS2 | | | A4 | 2418 114.0 | | B4 | 2426 16.0 |
| 12-Mar-00 00:41:00 WS2 | | | A5 | 2419 134.0 | | B5 | 2427 10.0 |
| 12-Mar-00 00:46:00 WS2 | | | A6 | 2420 73.0 | | B6 | 2428 0.4 |
| 12-Mar-00 00:51:00 WS2 | | | A7 | 2421 51.0 | | B7 | 2429 0.1 |
| 12-Mar-00 01:08:00 WS2 | | | A8 | 2422 43.0 | | B8 | 2430 0.1 |
| 09-Apr-00 00:30:00 WS3 | | | A1 | 2858 191.0 | | B1 | 2866 11.0 |
| 09-Apr-00 00:35:00 WS3 | | | A2 | 2859 240.0 | | B2 | 2867 7.0 |
| 09-Apr-00 00:40:00 WS3 | | | A3 | 2860 396.0 | | B3 | 2868 6.0 |
| 09-Apr-00 00:45:00 WS3 | | | A4 | 2861 84.0 | | B4 | 2869 4.0 |
| 09-Apr-00 00:50:00 WS3 | | | A5 | 2862 80.0 | | B5 | 2870 7.0 |
| 09-Apr-00 00:55:00 WS3 | | | A6 | 2863 73.0 | | B6 | 2871 7.0 |
| 09-Apr-00 01:00:00 WS3 | | | A7 | 2864 124.0 | | B7 | 2872 8.0 |
| 07-May-00 12:33:00 WS4 | | | A1 | 3017 207.5 | | B1 | 3029 46.0 |
| 07-May-00 12:38:00 WS4 | | | A2 | 3018 102.5 | | B2 | 3030 42.0 |
| 07-May-00 12:43:00 WS4 | | | A3 | 3019 106.5 | | B3 | 3031 33.5 |
| 07-May-00 12:48:00 WS4 | | | A4 | 3020 82.5 | | B4 | 3032 16.5 |
| 07-May-00 12:53:00 WS4 | | | A5 | 3021 53.5 | | B5 | 3033 17.5 |
| 07-May-00 12:58:00 WS4 | | | A6 | 3022 25.5 | | B6 | 3034 20.0 |
| 07-May-00 13:03:00 WS4 | | | A7 | 3023 10.5 | | B7 | 3035 13.0 |
| 07-May-00 13:03:00 WS4 | | | A8 | 3024 10.5 | | B8 | 3036 9.5 |
| 07-May-00 13:38:00 WS4 | | | A9 | 3025 26.0 | | B9 | 3037 7.5 |
| 07-May-00 14:03:00 WS4 | | | A10 | 3026 6.0 | | B10 | 3038 20.0 |
| 07-May-00 17:52:00 WS4 | | | A11 | 3027 15.5 | | B11 | 3039 8.5 |
| 07-May-00 19:25:00 WS4 | | | A12 | 3028 12.5 | | B12 | 3040 10.5 |
| 11-May-00 21:55:00 WS5 | | | A1 | 3195 99.5 | | B1 | 3214 34.5 |
| 11-May-00 22:00:00 WS5 | | | A2 | 3196 66.0 | | B2 | 3215 22.5 |
| 11-May-00 22:05:00 WS5 | | | A3 | 3197 54.0 | | B3 | 3216 11.5 |
| 11-May-00 22:10:00 WS5 | | | A4 | 3198 60.5 | | B4 | 3217 8.5 |
| 11-May-00 22:15:00 WS5 | | | A5 | 3199 73.5 | | B5 | 3218 7.0 |
| 11-May-00 22:20:00 WS5 | | | A6 | 3200 19.5 | | B6 | 3219 2.5 |
| 11-May-00 22:25:00 WS5 | | | A7 | 3201 26.0 | | B7 | 3220 0.5 |
| 11-May-00 23:07:00 WS5 | | | A8 | 3202 69.5 | | B8 | 3221 5.5 |
| 11-May-00 23:40:00 WS5 | | | A9 | 3203 34.5 | | B9 | 3222 7.0 |
| 12-May-00 00:13:00 WS5 | | | A10 | 3204 15.5 | | B10 | 3223 2.5 |
| 12-May-00 02:36:00 WS5 | | | A11 | 3205 4.5 | | B11 | 3224 4.0 |
| 12-May-00 03:41:00 WS5 | | | A12 | 3206 2.5 | | B12 | 3225 0.5 |
| 12-May-00 04:43:00 WS5 | | | A13 | 3207 3.0 | | B13 | 3226 0.5 |

**ENVIROPOD FILTER TRIAL
WAIRAU ROAD - NORTH SHORE CITY COUNCIL
LABORATORY RESULTS SUMMARY TABLE**

Compiled by: Matthew Musson
Date: 18-Jan-01

| Date - Time | Storm Number | UPSTREAM | | | | DOWNSTREAM | | | |
|------------------------|-----------------|-----------------|------------------|----------------------|-----------------------|-----------------|------------------|----------------------|-----------------------|
| | | Field Number | Sample Number | Laboratory Number | Concentration mg/l | Field Number | Sample Number | Laboratory Number | Concentration mg/l |
| 12-May-00 05:33:00 WS5 | | | A14 | 3208 | 25.5 | | B14 | 3227 | 11.5 |
| 12-May-00 05:55:00 WS5 | | | A15 | 3209 | 2.0 | | B15 | 3228 | 2.0 |
| 12-May-00 07:12:00 WS5 | | | A16 | 3210 | 15.5 | | B16 | 3229 | 11.0 |
| 12-May-00 08:16:00 WS5 | | | A17 | 3211 | 37.0 | | B17 | 3230 | 0.5 |
| 12-May-00 08:37:00 WS5 | | | A18 | 3212 | 23.0 | | B18 | 3231 | 2.0 |
| 12-May-00 09:29:00 WS5 | | | A19 | 3213 | 16.0 | | B19 | 3232 | 1.5 |
| | | | | | | | | | |
| 28-Jul-00 04:16:00 WS6 | | | A1 | 4074 | 180.0 | | B1 | 4085 | 45.0 |
| 28-Jul-00 04:21:00 WS6 | | | A2 | 4075 | 196.0 | | B2 | 4086 | 16.0 |
| 28-Jul-00 04:26:00 WS6 | | | A3 | 4076 | 133.0 | | B3 | 4087 | 1.0 |
| 28-Jul-00 04:31:00 WS6 | | | A4 | 4077 | 92.0 | | B4 | 4088 | 3.0 |
| 28-Jul-00 04:36:00 WS6 | | | A5 | 4078 | 109.0 | | B5 | 4089 | 4.0 |
| 28-Jul-00 04:41:00 WS6 | | | A6 | 4079 | 113.0 | | B6 | 4090 | 4.0 |
| 28-Jul-00 04:46:00 WS6 | | | A7 | 4080 | 65.0 | | B7 | 4091 | 2.0 |
| 28-Jul-00 05:18:00 WS6 | | | A8 | 4081 | 50.0 | | B8 | 4092 | 4.0 |
| 28-Jul-00 07:57:00 WS6 | | | A9 | 4082 | 57.0 | | B9 | 4093 | 11.0 |
| 28-Jul-00 11:35:00 WS6 | | | A10 | 4083 | 68.0 | | B10 | 4094 | 13.0 |
| 28-Jul-00 14:55:00 WS6 | | | A11 | 4084 | 45.0 | | B11 | 4095 | 6.0 |
| | | | | | | | | | |
| 01-Aug-00 12:48:00 WS7 | | | A1 | 4160 | 273.0 | | B1 | 4167 | 12.0 |
| 01-Aug-00 12:53:00 WS7 | | | A2 | 4161 | 218.0 | | B2 | 4168 | 16.0 |
| 01-Aug-00 12:58:00 WS7 | | | A3 | 4162 | 196.0 | | B3 | 4169 | 15.0 |
| 01-Aug-00 13:03:00 WS7 | | | A4 | 4163 | 160.0 | | B4 | 4170 | 20.0 |
| 01-Aug-00 13:08:00 WS7 | | | A5 | 4164 | 142.0 | | B5 | 4171 | 14.0 |
| 01-Aug-00 13:13:00 WS7 | | | A6 | 4165 | 142.0 | | B6 | 4172 | 18.0 |
| 01-Aug-00 13:18:00 WS7 | | | A7 | 4166 | 120.0 | | B7 | 4173 | 15.0 |
| | | | | | | | | | |
| 11-Aug-00 14:09:00 WS8 | | | A1 | 4271 | 333.0 | | B1 | 4282 | 84.0 |
| 11-Aug-00 14:14:00 WS8 | | | A2 | 4272 | 132.0 | | B2 | 4283 | 73.0 |
| 11-Aug-00 14:19:00 WS8 | | | A3 | 4273 | 93.0 | | B3 | 4284 | 65.0 |
| 11-Aug-00 14:24:00 WS8 | | | A4 | 4274 | 69.0 | | B4 | 4285 | 24.0 |
| 11-Aug-00 14:29:00 WS8 | | | A5 | 4275 | 60.0 | | B5 | 4286 | 37.0 |
| 11-Aug-00 14:34:00 WS8 | | | A6 | 4276 | 79.0 | | B6 | 4287 | 20.0 |

Cooke Laboratories

Version 1,3012/97

Report No:1020200

CLQM/4.16/11/01

Date: 5 February 2000

Client: Enviropod,
PO Box 105543,
CPO Auckland.

For the attention of: Mike Hannah

Sample description:

Your identification

| | |
|------|--------------|
| 'A1' | water sample |
| 'A2' | water sample |
| 'A3' | water sample |
| 'A4' | water sample |
| 'A5' | water sample |
| 'A6' | water sample |
| 'A7' | water sample |
| 'A8' | water sample |
| 'B1' | water sample |
| 'B2' | water sample |
| 'B3' | water sample |
| 'B4' | water sample |
| 'B5' | water sample |
| 'B6' | water sample |
| 'B7' | water sample |
| 'B8' | water sample |

Lab identification

| |
|------|
| 2000 |
| 2001 |
| 2002 |
| 2003 |
| 2004 |
| 2005 |
| 2006 |
| 2007 |
| 2008 |
| 2009 |
| 2010 |
| 2011 |
| 2012 |
| 2013 |
| 2014 |
| 2015 |

Sample status:

samples tested as received

Date sample received:

1/01/00

Date sample tested:

3/01/00

Methods used:

Methods for the examination of water and wastewater, APHA,1992

Analytical results:

Lab

Suspended solids

Identification (mg/L)

2000

87.5

| | |
|------|-------|
| 2001 | 68.0 |
| 2002 | 69.5 |
| 2003 | 71.5 |
| 2004 | 63.0 |
| 2005 | 60.0 |
| 2006 | 50.5 |
| 2007 | 228.0 |

Report No:1020200

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| Lab | | Suspended solids |
|-----------------------|--------|-------------------------|
| Identification | (mg/L) | |
| 2008 | | 20.0 |
| 2009 | | 17.0 |
| 2010 | | 13.5 |
| 2011 | | 15.0 |
| 2012 | | 12.0 |
| 2013 | | 13.0 |
| 2014 | | 44.5 |
| 2015 | | 145.5 |

| |
|---|
| Results refer only to the test item(s) tested. This report must not be altered or reproduced except in full |
|---|

Bryan Cooke MSc DpBact.

Cooke Laboratories

Version 1,3012/97

Report No:1310300

CLQM/4.16/11/01

Date: 19 March 2000

Client: Enviropod,
PO Box 105543,
CPO Auckland.

For the attention of: Mike Hannah

Sample description:

Your identification

| | |
|------|--------------|
| 'A1' | water sample |
| 'A2' | water sample |
| 'A3' | water sample |
| 'A4' | water sample |
| 'A5' | water sample |
| 'A6' | water sample |
| 'A7' | water sample |
| 'A8' | water sample |
| 'B1' | water sample |
| 'B2' | water sample |
| 'B3' | water sample |
| 'B4' | water sample |
| 'B5' | water sample |
| 'B6' | water sample |
| 'B7' | water sample |
| 'B8' | water sample |

Lab identification

| |
|------|
| 2415 |
| 2416 |
| 2417 |
| 2418 |
| 2419 |
| 2420 |
| 2421 |
| 2422 |
| 2423 |
| 2424 |
| 2425 |
| 2426 |
| 2427 |
| 2428 |
| 2429 |
| 2430 |

Sample status: samples tested as received

Date sample received: 15/03/00

Date sample tested: 16/03/00

Methods used: Methods for the examination of water and wastewater, APHA,1992

Analytical results:

Lab

Identification (mg/L)

2415

Suspended solids

376

| | |
|------|-----|
| 2416 | 295 |
| 2417 | 206 |
| 2418 | 114 |
| 2419 | 134 |
| 2420 | 73 |
| 2421 | 51 |
| 2422 | 43 |

Report No:1310300

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2 of 2

| Lab | | Suspended solids |
|-----------------------|--------|-------------------------|
| Identification | (mg/L) | |
| 2423 | | 16 |
| 2424 | | 14 |
| 2425 | | 13 |
| 2426 | | 16 |
| 2427 | | 10 |
| 2428 | | 0.4 |
| 2429 | | 0.1 |
| 2430 | | 0.1 |

Results refer only to the test item(s) tested. This report must not be altered or reproduced except in full

Bryan Cooke MSc DpBact.

Cooke Laboratories

Version 1,3012/97

Report No:1680400

CLQM/4.16/11/01

Date: 1 May 2000

Client: Enviropod,
PO Box 105543,
CPO Auckland.

For the attention of: Mike Hannah

Sample status: samples tested as received

Date sample received: 27/04/00

Date sample tested: 29/04/00

Methods used: Methods for the examination of water and wastewater, APHA,1992

Sample description/Analytical results:

| Your identification | Lab identification | Suspended solids* |
|---------------------|--------------------|-------------------|
| 'A1' | water sample | 2858 |
| 'A2' | water sample | 2859 |
| 'A3' | water sample | 2860 |
| 'A4' | water sample | 2861 |
| 'A5' | water sample | 2862 |
| 'A6' | water sample | 2863 |
| 'A7' | water sample | 2864 |
| 'A8' | water sample | 2865 |
| 'B1' | water sample | 2866 |
| 'B2' | water sample | 2867 |
| 'B3' | water sample | 2868 |
| 'B4' | water sample | 2869 |
| 'B5' | water sample | 2870 |
| 'B6' | water sample | 2871 |
| 'B7' | water sample | 2872 |

*(mg/L)

Results refer only to the test item(s) tested. This report must not be altered or reproduced except in full

Bryan Cooke MSc DpBact

Cooke Laboratories

Version 1,3012/97

Report No:1500500

CLQM/4.16/11/01

Date: 20 May 2000

Client: Enviropod,
PO Box 105543,
CPO Auckland.

For the attention of: Brendon

Sample status: samples tested as received

Date sample received: 9/05/00

Date sample tested: 12/05/00

Methods used: Methods for the examination of water and wastewater, APHA,1992

Sample description/Analytical results:

| Your identification | Lab identification | Suspended solids* |
|---------------------|--------------------|-------------------|
| 'A1' | water sample 3017 | 207.5 |
| 'A2' | water sample 3018 | 102.5 |
| 'A3' | water sample 3019 | 106.5 |
| 'A4' | water sample 3020 | 82.5 |
| 'A5' | water sample 3021 | 53.5 |
| 'A6' | water sample 3022 | 25.5 |
| 'A7' | water sample 3023 | 10.5 |
| 'A8' | water sample 3024 | 10.5 |
| 'A9' | water sample 3025 | 26.0 |
| 'A10' | water sample 3026 | 6.0 |
| 'A11' | water sample 3027 | 15.5 |
| 'A12' | water sample 3028 | 12.5 |
| 'B1' | water sample 3029 | 46.0 |
| 'B2' | water sample 3030 | 42.0 |
| 'B3' | water sample 3031 | 33.5 |
| 'B4' | water sample 3032 | 16.5 |
| 'B5' | water sample 3033 | 17.5 |
| 'B6' | water sample 3034 | 20.0 |
| 'B7' | water sample 3035 | 13.0 |
| 'B8' | water sample 3036 | 9.5 |
| 'B9' | water sample 3037 | 7.5 |
| 'B10' | water sample 3038 | 20.0 |
| 'B11' | water sample 3039 | 8.5 |

| | | | |
|-------|--------------|------|------|
| 'B12' | water sample | 3040 | 10.5 |
| 'B13' | water sample | 3041 | 15.0 |

Cooke Laboratories

Version 1,3012/97

Report No:1840500

CLQM/4.16/11/01

Date: 30 May 2000

Client: Enviropod,
PO Box 105543,
CPO Auckland.

For the attention of: Brendon

Sample status: samples tested as received

Date sample received: 19/05/00

Date sample tested: 21/05/00

Methods used: Methods for the examination of water and wastewater, APHA,1992

Sample description/Analytical results:

| Your ID | Lab ID | Suspended solids* | Your ID | Lab ID | Suspended solids* |
|-------------|--------|-------------------|-------------|--------|-------------------|
| 'A1',water | 3195 | 99.5 | 'B1',water | 3214 | 34.5 |
| 'A2',water | 3196 | 66.0 | 'B2',water | 3215 | 22.5 |
| 'A3',water | 3197 | 54.0 | 'B3',water | 3216 | 11.5 |
| 'A4',water | 3198 | 60.5 | 'B4',water | 3217 | 8.5 |
| 'A5',water | 3199 | 73.5 | 'B5',water | 3218 | 7.0 |
| 'A6',water | 3200 | 19.5 | 'B6',water | 3219 | 2.5 |
| 'A7',water | 3201 | 26.0 | 'B7',water | 3220 | 0.5 |
| 'A8',water | 3202 | 69.5 | 'B8',water | 3221 | 5.5 |
| 'A9',water | 3203 | 34.5 | 'B9',water | 3222 | 7.0 |
| 'A10',water | 3204 | 15.5 | 'B10',water | 3223 | 2.5 |
| 'A11',water | 3205 | 4.5 | 'B11',water | 3224 | 4.0 |
| 'A12',water | 3206 | 2.5 | 'B12',water | 3225 | 0.5 |
| 'A13',water | 3207 | 3.0 | 'B13',water | 3226 | 0.5 |
| 'A14',water | 3208 | 25.5 | 'B14',water | 3227 | 11.5 |
| 'A15',water | 3209 | 2.0 | 'B15',water | 3228 | 2.0 |
| 'A16',water | 3210 | 15.5 | 'B16',water | 3229 | 11.0 |
| 'A17',water | 3211 | 37.0 | 'B17',water | 3230 | 0.5 |
| 'A18',water | 3212 | 23.0 | 'B18',water | 3231 | 2.0 |
| 'A19',water | 3213 | 16.0 | 'B19',water | 3232 | 1.5 |

* (mg/L)

Cooke Laboratories

Version 1,3012/97

Report No:1300800

CLQM/4.16/11/01

Date: 11 August 2000

Client: Enviropod,
PO Box 105543,
CPO Auckland.

For the attention of: Brendon

Sample status: samples tested as received

Date sample received: 9/8/00

Date sample tested: 10/8/00

Methods used: Methods for the examination of water and wastewater, APHA,1992

Sample description/Analytical results:

| Your | Lab | Suspended solids* | Your | Lab | Suspended solids* |
|------------|------|-------------------|------------|------|-------------------|
| ID | ID | ID | ID | ID | ID |
| 'A1',water | 4160 | 273 | 'B1',water | 4167 | 12 |
| 'A2',water | 4161 | 218 | 'B2',water | 4168 | 16 |
| 'A3',water | 4162 | 196 | 'B3',water | 4169 | 15 |
| 'A4',water | 4163 | 160 | 'B4',water | 4170 | 20 |
| 'A5',water | 4164 | 142 | 'B5',water | 4171 | 14 |
| 'A6',water | 4165 | 142 | 'B6',water | 4172 | 18 |
| 'A7',water | 4166 | 120 | 'B7',water | 4173 | 15 |

*(mg/L)

Results refer only to the test item(s) tested. This report must not be altered or reproduced except in full

Cooke Laboratories

Version 1,3012/97

Report No:1720800

CLQM/4.16/11/01

Date: 22 August 2000

Client: Enviropod,
PO Box 105543,
CPO Auckland.

For the attention of: Mike

Sample status: samples tested as received

Date sample received: 18/8/00

Date sample tested: 22/8/00

Methods used: Methods for the examination of water and wastewater, APHA,1992

Sample description/Analytical results:

| Your | Lab | Suspended | Your | Lab | |
|-------------|-----------|-----------|---------------|------|-----|
| | Suspended | | | | |
| ID | | ID | | | |
| | | solids* | | ID | |
| | | ID | | | |
| | | solids* | | | |
| | | | | | |
| 'A1',water | 4271 | 333 | 'B1',water | 4282 | 84 |
| 'A2',water | 4272 | 132 | 'B2',water | 4283 | 73 |
| 'A3',water | 4273 | 93 | 'B3',water | 4284 | 65 |
| 'A4',water | 4274 | 69 | 'B4',water | 4285 | 24 |
| 'A5',water | 4275 | 60 | 'B5',water | 4286 | 37 |
| 'A6',water | 4276 | 79 | 'B6',water | 4287 | 20 |
| 'A7',water | 4277 | - | 'B12 ?',water | 4288 | 1.5 |
| 'A8',water | 4278 | 77 | 'B8',water | 4289 | 28 |
| 'A9',water | 4279 | 16 | 'B9',water | 4290 | 19 |
| 'A10',water | 4280 | 60 | 'B10',water | 4291 | 1.5 |
| 'A11',water | 4281 | 86 | 'B11',water | 4292 | 14 |

* (mg/L)

- no sample