



Grafton Road Stormwater Retention Tank Sediment Analysis

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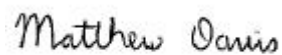
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Grafton Road Stormwater Retention Tank Sediment Analysis

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Prepared for
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1 Introduction

The Auckland Regional Council (ARC) is interested in investigating the contaminant concentrations of sediment in road run-off captured by stormwater treatment devices. The stormwater retention tank at Grafton Road has been selected for investigation because it traps sediment and contaminants from only the surface of a new motorway, ie contaminants from historic road building materials and from other contaminants sources are excluded. The road surface-only source provided the opportunity to obtain definitive data for the zinc/copper and zinc/total petroleum hydrocarbons (TPH) ratios in road run-off, two ratios that are highly variable throughout existing data for unknown reasons. This report complements a previous report (Depree and Ahrens 2007) that describes the sources, concentrations and potential environmental risks of polycyclic aromatic hydrocarbons (PAHs) in Auckland's aquatic environments.

The stormwater retention tank at Grafton Road is the largest stormwater treatment device in New Zealand (100 x 10 x 2.5 m) and captures sediment in the 85 m settling zone (see Figure 1). This is a three bay system – ie inlet (Figure 2), forebay (Figure 3), main settling tank (Figure 4 and 5) and all of these capture sediment, including the inlet – ie coarse removed at inlet and finest removed in settling tank. The device captures coarse sediments that would otherwise be discharged directly into streams and fine sediments that may eventually settle in estuaries. The aim of this project is to characterise the metal contaminants in different size fractions removed by the stormwater treatment device.

Figure 1
Sample locations within the retention tank.



Courtesy of NIWA

Figure 2

Inside view of Grafton Road inlet, ie first chamber which concentrates the coarse material.



Courtesy of NIWA

Figure 3

Inside view of Grafton Road forebay: inlet located to the left (water enters forebay via the holes in the wall).



Courtesy of NIWA

Figure 4

Inside view of Grafton Road: looking into main tank (forebay in the foreground).



Courtesy of NIWA

Figure 5

Inside view of Grafton Road: main tank looking towards forebay.



Courtesy of NIWA

2 Methodology

Sediments captured from road run-off from the motorway were sampled along the length of the stormwater treatment device (see Figure 1). Sample collection was conducted as part of a Land Transport NZ-funded research programme, Contaminant Characterisation and Toxicity of Road Sweepings and Catchpit Sediments (Depree 2008). Sediments were collected from each of the sampling sites, and frozen immediately on return to the NIWA Laboratory, Auckland.

Each sediment sample was homogenised and two sub-samples were taken. The first sub-sample was analysed for TPH by gas chromatography-flame ionization detector (GC-FID) at R J Hill Laboratories Ltd in Hamilton according to method US EPA 8015B/NZ OIEWG. The second sub-sample was analysed for metals.

The sediment for metal analysis was extracted with dichloromethane (DCM) until the extracts were clear. The extracts were discarded and the oil-free solids retained were evaporated to remove excess DCM. A sub-sample (10 g) was weighed and dried at 60°C to obtain the dry weight. The remainder of the oil-free solids was wet sieved to four size fractions; <25 µm, 25-63 µm, 63-150 µm and >150 µm. A 5 g sample was taken from each sieved size fraction and dried at 60°C. A sub-sample (0.1-0.5 g) of each dried size fraction was taken, homogenised and digested for 30 mins at 95°C in nitric/hydrochloric acid (2 mL conc. HNO₃ 2 mL conc. HCl: 10 mL water according to USEPA 200.2 method). Samples were diluted 10x with one per cent nitric acid prior to analysis to reduce acid strength and centrifuged at 2500 rpm for ten minutes to remove suspended solids. The extracts were decanted into clean plastic tubes and analysed for copper, zinc and lead by Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS) according to APHA method 3125B.

3 Results

Table 1

Total metal concentrations in sediments (mg kg^{-1} dw) at the Inlet at Grafton Road stormwater retention tank.

Sediment size (μm)	Copper	Lead	Zinc	Ratio of Zn:Cu	Ratio of Zn:Pb	Ratio of Cu:Pb
0-25	416	257	2450	5.9	9.5	1.6
25-63	325	167	1290	4.0	7.7	1.9
63-150	140	66	354	2.5	5.4	2.1
>150	62	26	408	6.6	15.5	2.3

Table 2

Total metal concentrations in sediments (mg kg^{-1} dw) at the Forebay at Grafton Road stormwater retention tank.

Sediment size (μm)	Copper	Lead	Zinc	Ratio of Zn:Cu	Ratio of Zn:Pb	Ratio of Cu:Pb
0-25	263	218	1790	6.8	8.2	1.2
25-63	178	150	992	5.6	6.6	1.2
63-150	155	121	774	5.0	6.4	1.3
>150	197	135	1180	6.0	8.7	1.5

Table 3

Total metal concentrations in sediments (mg kg^{-1} dw) at site #1 at Grafton Road stormwater retention tank.

Sediment size (μm)	Copper	Lead	Zinc	Ratio of Zn:Cu	Ratio of Zn:Pb	Ratio of Cu:Pb
0-25	254	210	1650	6.5	7.9	1.2
25-63	143	131	807	5.6	6.2	1.1
63-150	112	97	658	5.9	6.8	1.2
>150	190	128	1200	6.3	9.4	1.5

Table 4

Total metal concentrations in sediments (mg kg^{-1} dw) at site #2 at Grafton Road stormwater retention tank.

Sediment size (μm)	Copper	Lead	Zinc	Ratio of Zn:Cu	Ratio of Zn:Pb	Ratio of Cu:Pb
0-25	195	186	1250	6.4	6.7	1.0
25-63	145	140	899	6.2	6.4	1.0
63-150	151	134	924	6.1	6.9	1.1
>150	204	168	1210	5.9	7.2	1.2

Table 5

Total metal concentrations in sediments (mg kg^{-1} dw) at site #3 at Grafton Road stormwater retention tank.

Sediment size (μm)	Copper	Lead	Zinc	Ratio of Zn:Cu	Ratio of Zn:Pb	Ratio of Cu:Pb
0-25	172	173	1090	6.3	6.3	1.0
25-63	142	145	908	6.4	6.3	1.0
63-150	184	166	1250	6.8	7.5	1.1
>150	148	121	866	5.9	7.2	1.2

Table 6

Total metal concentrations in sediments (mg kg^{-1} dw) at site #4 at Grafton Road stormwater retention tank.

Sediment size (μm)	Copper	Lead	Zinc	Ratio of Zn:Cu	Ratio of Zn:Pb	Ratio of Cu:Pb
0-25	184	174	1080	5.9	6.2	1.1
25-63	181	172	1180	6.5	6.9	1.1
63-150	210	180	1390	6.6	7.7	1.2
>150	183	165	1090	6.0	6.6	1.1

Table 7TPH concentrations in sediments (mg kg⁻¹ dw) at the Grafton Road stormwater retention tank.

Site	Wet weight (g)	DM (%)	C7-C9	C10-C14	C15-C36	TOTAL
Inlet	16.21	80.1	< 9	< 20	890	890
Forebay	17.32	56.6	< 10	< 30	3970	3970
Site #1	13.86	49.6	< 10	< 30	5610	5610
Site #2	14.94	54.8	< 10	< 30	5740	5740
Site #3	14.32	56.8	< 10	< 30	3490	3490
Site #4	15.09	57.4	< 10	< 20	3010	3010
Site #5	16.29	52.4	< 10	< 30	4030	4030

4 Acknowledgements

The author would like to acknowledge Dr Craig Depree from NIWA for the sample collection.

5 References

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