

Report Number
Page

Manukau City - OLD LANDFILL TESTING

Location: **ELM PARK**

LABORATORY RESULTS

Parameter	Units	Results	
		Up Stream	Down Stream
Site			
Type of Site			
SAMPLE			
Lab sample No		992AM	993AM
Method of collection		Bailer	Bailer
Lab Used		SGS	SGS
ANALYSIS			
Boron	mg/L	0.33	0.060
Chromium	mg/L	0.0006	0.0013
Copper	mg/L	0.0027	0.0047
Lead	mg/L	0.0007	0.0019
Manganese	mg/L	0.0897	0.102
Zinc	mg/L	0.048	0.059
Iron	mg/L	0.72	1.01
Cadmium	mg/L	<0.00005	<0.00005
TOC	ppm	7.2	4.7
Nitrate - N	mgNO ₃ -N/L	4.6	4.8
Nitrite - N	mgNO ₂ -N/L	0.02	0.02
Total Ammoniacal Nitrogen	mgNH ₃ -N/L	<0.2	<0.2
Chloride	mg/L	25	100
Salinity	mg/L	45	181

Tested by: SPJ Date: 12.10.99
 Checked by: TB Date: 8.11.99

10/11/99

12:33

MANUKAU CONSULTANTS → 64 9 2625131

NO.027

008

Report Number: 21 2212 00
Page**Manukau City - OLD LANDFILL TESTING**

Location:

BAIRDS ROAD

STREAM SAMPLING

Parameter	Units	Results	
Site			
Type of Site		Up stream	Down Stream
Date - of sampling		11.10.99	11.10.99
Time - sampling		1.20pm	2.05pm
Low tide		3.35pm	3.35pm
Weather		Fine	Fine
MEASUREMENTS			
pH	-	6.15	6.42
Dissolved Oxygen	mg/l	6.20	6.10
Conductivity	mS/m	19.71	14.41
Clarity		Clear	Clear
Visual Inspection		Flowing	Flowing
SAMPLE Number			
Lab sample No		989AM	990AM
Lab Used		SGS	SGS
Method of collection		Bailer	Bailer

Tested by: SPJ

Date: 11.10.99

Checked by: TB

Date: 8.11.99

10/11/99

12:33

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NO. 027

009

Report Number

Page

Manukau City - OLD LANDFILL TESTING

Location:

BAIRDS ROAD**LABORATORY RESULTS**

Parameter	Units	Results	
		Up Stream	Down Stream
Site			
Type of Site		Up Stream	Down Stream
SAMPLE			
Lab sample No		989AM	990AM
Method of collection		Bailer	Bailer
Lab Used		SGS	SGS
ANALYSIS			
Boron	mg/L	0.056	0.056
Chromium	mg/L	0.0009	0.0008
Copper	mg/L	0.0048	0.0037
Lead	mg/L	0.002	0.0014
Manganese	mg/L	0.107	0.104
Zinc	mg/L	0.074	0.074
Iron	mg/L	0.86	0.79
Cadmium	mg/L	0.00008	0.00005
TOC	ppm	6.2	6.4
Nitrate - N	mgNO ₃ -N/L	2.5	2.6
Nitrite - N	mgNO ₂ -N/L	0.01	0.02
Total Ammoniacal Nitrogen	mgNH ₃ -N/L	0.6	0.3
Chloride	mg/L	15	15
Salinity	mg/L	27	27

Tested by:

SPJ

Date:

11.10.99

Checked by:

TB

Date:

8.11.99

10/11/99

12:33

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NO. 027

D10

Report Number : 21 2212 00

Page

Manukau City - OLD LANDFILL TESTING

Location:

COXHEAD PARK

STREAM SAMPLING

Parameter	Units	Results	
Site			
Type of Site		Up stream	Down Stream
Date - of sampling		11.10.99	11.10.99
Time - sampling		3.00PM	3.20PM
Low tide		N/A	N/A
Weather		Fine	Fine
MEASUREMENTS			
pH	-	6.78	6.80
Dissolved Oxygen	mg/l	8.40	8.60
Conductivity	mS/m	17.25	17.76
Clarity		Clear	Clear
Visual Inspection		Flowing	Flowing
SAMPLE Number			
Lab sample No		967AM	968AM
Lab Used		SGS	SGS
Method of collection		Bailer	Bailer

Tested by: SPJ

Date: 11.10.99

Checked by: TB

Date: 8.11.99

Report Number
Page

Manukau City - OLD LANDFILL TESTING

Location: **COXHEAD PARK**

LABORATORY RESULTS

Parameter	Units	Results	
		Up Stream	Down Stream
Site			
Type of Site		Up Stream	Down Stream
SAMPLE			
Lab sample No		967AM	968AM
Method of collection		Bailer	Bailer
Lab Used		SGS	SGS
ANALYSIS			
Boron	mg/L	0.045	0.046
Chromium	mg/L	0.0008	0.0007
Copper	mg/L	0.0014	0.0012
Lead	mg/L	0.0005	0.0003
Manganese	mg/L	0.0378	0.0384
Zinc	mg/L	0.032	0.032
Iron	mg/L	0.26	0.22
Cadmium	mg/L	<0.00005	<0.00005
TOC	ppm	1.6	2.2
Nitrate - N	mgNO ₃ -N/L	3.1	3.6
Nitrite - N	mgNO ₂ -N/L	0.01	0.01
Total Ammoniacal Nitrogen	mgNH ₃ -N/L	0.3	0.8
Chloride	mg/L	15	15
Salinity	mg/L	27	27

Tested by: SPJ Date: 11.10.99
Checked by: TB Date: 0.11.99



Appendix D

Data for Great South Road

Borehole Samples

GREAT SOUTH ROAD OLD LANDFILL BOREHOLE MONITORING RECORD

SGS LAB NUMBER: 0834/00
GHD REPORT NUMBER: 21 2530 00

Page 2 of 4

PARAMETER	UNIT	Borehole 1	Borehole 2
Depth of Borehole	m	6.23	6.07
Depth to water level	m	3.09	3.11
Date sampled	-	24.3.00	24.3.00
Time sampled		12.00pm	11.25am
pH	-	5.93	6.64
Conductivity	mS/m	28.4	485
Temperature	Deg C	17.8	18.9
Observations	-	Rusty smell, cloudy and orange	Sulphurous odour, cloudy and yellow grey
Organochlorine Pesticides			
Alpha – BHC	mg/kg	<0.01	<0.01
Beta – BHC	mg/kg	<0.01	<0.01
Lindane	mg/kg	<0.01	<0.01
Heptachlor	mg/kg	<0.01	<0.01
Aldrin	mg/kg	<0.01	<0.01
Heptachlorepoxyde	mg/kg	<0.01	<0.01
Endosulfan I	mg/kg	<0.01	<0.01
DDE	mg/kg	<0.01	<0.01
Dieldrin	mg/kg	<0.01	<0.01
Endrin	mg/kg	<0.01	<0.01
Sample Numbers		427AR	428AR

Sampled by ;

TB & RC

Date ; 24 3.00

Transpositions Checked By ;

TB

Date ; 17.04.00

SGS LAB NUMBER: 0834/00

Report Number : 21 2530 00

Page 3 of 4

PARAMETER	UNIT	Borehole 1	Borehole 2
O, P' – DDT	mg/kg	<0.01	<0.01
Endosulfan II	mg/kg	<0.01	<0.01
P, P' – DDD	mg/kg	<0.01	<0.01
P, P' – DDT	mg/kg	<0.01	<0.01
Methoxychlor	mg/kg	<0.01	<0.01
BTEX			
Benzene	mg/lt	<0.01	<0.01
Toluene	mg/lt	<0.01	<0.01
Ethyl benzene	mg/lt	<0.01	<0.01
Xylenes	mg/lt	<0.01	<0.01
Polyaromatic Hydrocarbons			
Naphthalene	mg/lt	<0.01	<0.01
Acenaphthalene	mg/lt	<0.01	<0.01
Acenaphthene	mg/lt	<0.01	<0.01
Flourene	mg/lt	<0.01	<0.01
Phenanthrene	mg/lt	<0.01	<0.01
Anthracene	mg/lt	<0.01	<0.01
Fluoranthene	mg/lt	<0.01	<0.01
Pyrene	mg/lt	<0.01	<0.01
Benz(a)anthracene	mg/lt	<0.01	<0.01
Chrysene	mg/lt	<0.01	<0.01
Benzo(b)fluoranthene	mg/lt	<0.01	<0.01
Benzo(k)fluoranthene	mg/lt	<0.01	<0.01
Benzo(a)pyrene	mg/lt	<0.01	<0.01
Indeno(1,2,3-cd)pyrene	mg/lt	<0.01	<0.01
Dibenz(a,h)anthracene	mg/lt	<0.01	<0.01
Benzo(ghi)perylene	mg/lt	<0.01	<0.01
Sample Numbers		427AR	428AR

Sampled by ;

TB & RC

Date ; 24.3.00

Transpositions Checked By ;

TB

Date ; 17.04.00

SGS LAB NUMBER: 0834/00

PARAMETER	UNIT	Borehole 1	Borehole 2
Phthalates			
Dimethylphthalate	mg/lit	<0.01	<0.01
Diethylphthalate	mg/lit	<0.01	<0.01
Dibutylphthalate	mg/lit	<0.01	<0.01
Benzylbutylphthalate	mg/lit	<0.01	<0.01
Bis(2-ethylhexyl)phthalate	mg/lit	<0.01	<0.01
Di-n-octylphthalate	mg/lit	<0.01	<0.01
PCB's			
PCB	mg/lit	<0.004	<0.004
Phenols			
Phenol	mg/lit	<0.01	<0.01
2-Chlorophenol	mg/lit	<0.01	<0.01
2-Methylphenol	mg/lit	<0.01	<0.01
3 & 4-Methylphenol	mg/lit	<0.01	<0.01
2-Nitrophenol	mg/lit	<0.01	<0.01
2,4-Dimethylphenol	mg/lit	<0.01	<0.01
2,4-Dichlorophenol	mg/lit	<0.01	<0.01
2,6-Dichlorophenol	mg/lit	<0.01	<0.01
4-Chloro-3-methylphenol	mg/lit	<0.01	<0.01
2,4,6-Trichlorophenol	mg/lit	<0.01	<0.01
2,4,5-Trichlorophenol	mg/lit	<0.01	<0.01
4-Nitrophenol	mg/lit	<0.01	<0.01
2,3,4,6-Tetrachlorophenol	mg/lit	<0.01	<0.01
2-Methyl-4,6-dinitrophenol	mg/lit	<0.01	<0.01
Pentachlorophenol	mg/lit	<0.01	<0.01
2-sec-Butyl-4,6-Dinitrophenol	mg/lit	<0.01	<0.01
Sample Numbers	-	427AR	428AR

Methodology : GC/MS after solvent extraction
GC/ECD after solvent extraction

Sampled By : TB & RC

Date : 24.3.00

Transpositions Checked By : TB

Date : 17.04.00

Analytes Measured

date collected location		B (mg/l)	Ca (mg/l)	Cd (mg/l)	Cr (mg/l)	Cu (mg/l)	Fe (mg/l)	K (mg/l)	Mg (mg/l)	Mn (mg/l)	Na (mg/l)	Pb (mg/l)	Zn (mg/l)	Cl (mg/l)	COD (mg/l)
26-Sep-94	Gt Sth Rd 1	0.25	55	<0.01	<0.01	<0.03	2.4	5.8	15	0.3	56	<0.2	0.26		163
26-Sep-94	Gt Sth Rd 2	0.38	75	<0.01	<0.01	<0.03	5.7	13	29	0.6	112	<0.2	0.13		265
24-Feb-95	Gt Sth Rd 1	0.5	75	0.06	<0.01	0.52	373	9.4	17.4	0.98	66	0.45	15.3		122
24-Feb-95	Gt Sth Rd 2	0.31	13.8	<0.01	<0.01	<0.03	2.8	2.5	2.6	0.06	13.9	<0.2	0.26		246
12-Sep-95	Gt South Rd 1	S 0.4	59	0.0009	0.002	0.015	11	8.3	13	0.8	47	0.013	0.49	-	35
12-Sep-95	Gt South Rd 3	S 0.35	32	0.0003	0.002	0.009	3.1	4.7	6.6	0.13	29	0.008	0.19	-	25
14-May-96				0.002	0.01	0.08	46			1.2		0.05	1.7		
14-May-96				<0.001	<0.002	0.02	3.3			0.3		0.007	0.07		
	blank	0.21	1.4	<0.01	<0.01	<0.03	0.14	1.3	0.2	0.006	3.1	<0.2	0.02		
	sea water	3.3	337	<0.1	<0.1	<0.3	0.3	331	1077	0.07	9283	<2	0.4		
	river water	<0.1	4.2	<0.01	<0.01	<0.03	5.9	6.1	7.5	0.13	24.4	<0.2	0.01		
	Greenmount	22		<0.01	0.19	0.07	128			13		0.18	25		10500
	ARC Trade Waste	25		1	30	10				20		10	25		
	USEPA Fresh Acute			0.0039	0.016	0.18						0.083	0.12		
	USEPA Marine Acute			0.043	1.1	0.0029						0.22	0.095		
	ANZECC Freshwater			*0.0002	0.01	*0.002	1					*0.001	*0.005		
	ANZECC Marine			0.002	0.05	0.005						0.005	0.05		

Analytes Measured

date collected location		NH4-N (mg/l)	Nitrite (mg/l)	Nitrate (mg/l)	NNN (mg/l)	Total N (mg/l)	TOC	DO	pH	EC	salinity	temp	odour	clarity	colour
26-Sep-94	Gt Sth Rd 1	0.12				0.59		4.1	6.56	510	0	16	swamp	clear	none
26-Sep-94	Gt Sth Rd 2	0.34				0.97		5.4	6.62	680	0.3	15	swamp	clear	none
24-Feb-95	Gt Sth Rd 1	2.5				57		0.5	6.88	700	100	22	org	opaque	dark grey
24-Feb-95	Gt Sth Rd 2	0.18				0.7		4	6.86	150	0	22	nil	clear	v lt yellow
12-Sep-95	Gt South Rd 1	S 0.35	-	-		0.75		0							
12-Sep-95	Gt South Rd 3	S 0.29	-	-		1.6		0							
14-May-96		2.9		0.007			10	0.95	6.98	100	<1	18	strong	opaque	black
14-May-96		1.1		0.006			6	2	6.59	27	0	20	nil	clear	or. br.
	blank														
	sea water														
	river water														
	Greenmount														
	ARC Trade Waste														
	USEPA Fresh Acute														
	USEPA Marine Acute														
	ANZECC Freshwater														
	ANZECC Marine														



Appendix E
Site Specific Data



Site Specific Data

This section contains the individual site reports of the seven MCC Old Landfills that may require additional review by the ARC. Each site report contains:

- basic data on the site and the condition index value
- description of the site itself, and the history
- a narrative of the main investigation and results
- a descriptive assessment of the importance of the site
- site map
- chemical analysis results

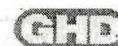
The basic data on the site includes such information as the estimated area, average depth and fill volume. The area and depth have been fairly well defined in most sites as a result of the borehole investigations. Where there is uncertainty, because the bore investigation data did not sufficiently define these quantities, an estimate of the quantities has been made.

Where no bores were dug and no other information was available, a conservative overestimate of the fill depth or area has been made. It is inferred that the fill areas are within the boundaries of the properties within which the old landfills are contained. The fill depth is taken to be the difference in height between the top surface of the fill and the natural ground at the base of the fill beyond the landfill footprint. The volume of fill has in all cases been taken as the product of these parameters.

The site maps (Appendix A) show the site location and the sampling points. The locations of the investigation bores are also shown in the maps.

1.1 Hills Road (Mayfield Park)

Site Name	Hills Rd
Filltype	Household
Estimated Fill Volume (m ³)	100000
Estimated Fill Area (ha)	2
Estimated Average Depth (m)	5
Road Location	Hills Rd, Mayfield Park
Suburb	Otara



Adjacent Watercourse	Otara Creek
Open	1963
Close	1967
Underlying Geology	Sedimentary materials of the Tauranga group
Legal Description	Allot 356 (SO 45686)
Leachate Strength (%)	11.01
Condition Index Value	6041

Note: The area of the main body Mayfield Park that contains the landfill is about 3 ha. However the depth of fill will vary over the site. The greatest depth of fill will be found in the former riverbed (where the bores installed on the site have been dug). The area located within the former bend of the river, was excavated for cover material being placed in the creek bed. This area was later filled also with refuse but the depth of refuse would be much less. To allow for this change in depth we have only allowed for a 'representative' fill area of 2 ha.

1.1.1 Location and Description

The site is in the area bordered by Hills Rd, the Otara Creek and Velvet Crescent in Otara. The area is now part of Mayfield Park.

The fill area is roughly oval in shape. The surface is moderately uneven and does not drain properly making it inadequate for contact sports particularly during winter. The filled areas show signs of settlement. This is consistent with fill consolidation as refuse decomposes.

The edge of the site along the Otara Creek drops steeply down to the mudflats. The eastern boundary slopes up at approximately 25 degrees bank to Hills Rd. A low stone wall has been built along the full length of the site above the Otara Creek bank.

The bulk of the site is mown grass with exotic trees around the perimeter. None exhibit any sign of stress that might be associated with landfill gas or leachate influence. The eastern bank of the Otara Creek has reeds, flax, weeds and young mangroves.

There are several springs on the banks of the Otara Creek. The strongest springs come out of the landfill at about the location of the route of the former creek.

1.1.2 *History*

Information about the site is from the recollections of long serving staff, past and present residents and some sketchy council records.

The site was originally used as the sewerage treatment plant for the original Housing Corporation subdivision of Otara. Following its acquisition by the then Manukau County the almost circular bend in the Otara River was straightened. The County filled the resulting ox bow lake. It was the major municipal dump for Manukau County at the time and received all types of household and commercial rubbish. There is no record of filling or earthworks on the western side of the present channel.

Written records and verbal reports from present and past residents show that local residents complained of many operational problems which resulted in such nuisances as rats, mosquitoes, flies, dust and odour etc.

1.1.3 *Surface Water and Ecology*

The catchment for the Otara creek contains many industrial, commercial, urban and rural areas. A breakdown of the zoning for the Otara Lake catchment is given in the report for the Ngati Otara site. Stormwater runoff and possible sewerage overflows affect water quality.

The Otara Creek flows south to north on the western edge of the site and is tidal at this point. The creek is very unsightly. The water appears dark, dead and polluted. However this is most likely due to industry and other pollutant sources in the catchment. Water quality results indicate high levels of biological pollutants (most probably as a result of sewer overflows).

Former residents reported that Otara Creek by the landfill was a very popular swimming spot with firm riverbeds and provided rich fishing grounds. The river is now heavily silted and is not safe for swimming or fishing.

Only a few small finned fish have been observed in the stream. A proper biological evaluation of the stream has not been done yet.

The Otara Lake, which is just downstream, is the subject of water quality initiatives by the MCC, ARC and ECNZ with intention of making the lake suitable for contact recreation. These initiatives may have to address problems in the catchment and thus there may be a positive effect on the water quality of the Otara Creek at Hills Rd.

1.1.4 *Drains*

Stormwater lines (225 diameter falling into 380 diameter) cross and fringe on the southern edge of the site. A 230 diameter sewer runs inside the stone wall on the western edge.

1.1.5 Surrounds

The Otara area is predominantly flat and low lying with some gentle rolling hills. There is residential housing on the southern and northern edges of the site and across Hills Rd on the western side. The site is part of Mayfield Park reserve, which runs to the north and south on the western side of the creek. In addition the drainage reserve to the creek runs further north and south. Mayfield school is within a couple of blocks of the site.

1.1.6 Water Sampling

Six monitoring stations were established. Site 4 just upstream and Site 5 just downstream of the landfill in the stream provide samples indicative of the impacts of landfill discharges on the stream water quality. There is the possibility that tidal effects will propagate contaminants and saline water upstream reducing the value of the control.

Site 1 sampled a spring, which according to the records is about the location of a piped outlet from one end of the filled former oxbow riverbed. The spring should allow direct measurement of the leachate. It is distinctly rusty possibly with iron oxide from the landfill.

Site 2 is located on the last manhole of a stormwater culvert before it discharges into the creek. The culvert skirts the southern boundary of the landfill. The joints in the manhole walls at Site 2 are noticeably encrusted with rusty oxide deposits. During wet weather they act as entry points for water into the manhole chamber. This suggests that groundwater from the surrounding filled area may be entering the manhole during wet weather and is possibly carrying leachate into the manhole. Sites 3 and 6 are stormwater manholes further up the grade on the same culvert.

In general sampling from culverts does have limitations namely that leachate will only be present in the culvert if it can get into the culvert. If the flow is not continuous then sampling on any particular day may not detect leachate. However the increased length of culvert through the fill area should increase the chance that leachate will enter the culvert.

1.1.7 Pooled Water Sampling

It is common for water to pool on this site during winter. MCC became concerned that water pooling on the site could contain leachate, which may pose a public health risk.

A special set of tests was carried out on the pooled water. The results are shown in table 10.

Table 10 : Parameters in Pond Water at Hills Rd

Parameter	Unit	Result
Cadmium	mg / l	<0.003
Copper	mg / l	0.02
Chromium	mg / l	0.03
Iron	mg / l	35
Lead	mg / l	0.03
Mangancsc	mg / l	1.8
Zinc	mg / l	0.1
Nitrate	mgNO ₃ - M/L	0.027
Nitrite	mgNO ₂ - M/L	<0.005
Total Ammonia Nitrogen	mgNH ₃ - M/L	1.9
Non-purgable organic carbon	mg / l	27

1.1.8 **Subsurface Investigations**

Four bores were drilled on site. They were located in areas that appeared to be settling and were likely to pick up the location of previous bend in the river that was filled.

The fill was 4 to 4.5m deep in the two bores closest to the present creek. It was 5 to 5.5m deep in the bores closest to the road. All four bores showed that Waitemata group materials underlay the fill. The water table was intercepted in all bores at a depth of around 1.5m. Piezometers were installed in all bores.

A mixture of clay fill and assorted refuse was found in all of the bores. Gas levels between 60% and 75% LEL were recorded in all of the bores.

The topsoil depth was approximately 0.2m.

1.1.9 **Consultation**

A letter drop to neighbouring residents took place in December 1994 to inform them what the investigation is for and to request information. No responses were received.

A report to the Otara Ward community board March 1995 meeting and a subsequent article in the Manukau Courier resulted in several callers providing historical information about this site.

1.1.10 **Results and Conclusions**

The water quality results taken for this investigation have shown a low level of contamination. While there are low concentrations of leachate indicators in the



spring at site 1, there is no detectable change in water quality between sampling stations 4 and 5.

In November 1998, Manukau City Council started a project to lay a clay cap on this landfill. The intention is to improve the year round usability of the park surface and reduce infiltration into the landfill below.

Overall, the indicative data obtained for the site in relation to the levels of environmental contaminants, were found to be below or close to the detection limits of the various parameters measured.

1.2 Pah Road (Papatoetoe Cemetery)

Site Name	Pah Rd
Filltype	Household
Estimated Fill Volume (m ³)	30000
Estimated Fill Area (ha)	0.5
Estimated Average Depth (M)	6
Road Location	Papatoetoe Cemetery
Suburb	Papatoetoe
Adjacent Watercourse	Waokauri Creek
Open	unknown
Close	1965
Underlying Geology	Pumiceous deposits of the Tauranga group
Legal Description	PT LOT 2 DP 11565
Leachate Strength (%)	20.94
Condition Index Value	2927

1.2.1 Location and Description

The site is located within the South Auckland cemetery. The cemetery is on the north side of Puhinui Rd several hundred metres from its intersection with Roscommon Rd. The cemetery is bound by the Waokauri creek to the west and the southwestern motorway to the east.

The landfill is now an open space park area within the cemetery. It is adjacent to the carparks outside the cemetery administration office. It falls gently westwards to the Waokauri creek. The surface is well maintained surrounded by scattered trees. There is no sign of settlement on the surface but it is possible that this is due to maintenance and continued local filling by cemetery staff. The grass and surrounding trees show no sign of distress.

The front face of the filled area is quite steep and is covered in weeds and scrubs. Underneath this vegetation there is rubble, metals and concrete etc. and other obstructions typical of old dumps. The fill area fringes onto the creek.

1.2.2 History

The fill was formed in part by filling a branch of the Waokauri Creek. Filled area also extended along the bank of the main tributary. The site was operated as the municipal rubbish dump by the Papatoetoe City Council and received all types of household and commercial refuse.

1.2.3 Surrounds

The Waokauri creek runs north to south on the western edge of the cemetery. The stream is relatively free flowing, relatively clear and flowing on both sides with an assortment of waterweeds. No aquatic life such as fish and eels were observed. There are mangroves starting on the Waokauri creek just to the south of the landfill area.

The land within the cemetery extends for several hundred metres to the north, east and south of the landfill site. The crematorium is about 100m to the southeast of the landfill area. The land in the cemetery all fall gently to the Waokauri Creek. Beyond the motorway approximately half a kilometre from the cemetery, there is residential housing. The land immediately on the other side of the creek from the landfill is being used for horticulture. Beyond that the surrounding land to the north, south and west is rural being used for agriculture and horticulture. In general the surrounding land beyond the cemetery is flat.

1.2.4 Water Sampling

Three sampling sites are located on the Waokauri Creek for surface water quality testing. Site 2 is the rusty spring just above the toe of the filled slope. Site 1 is just downstream of the spring at the base of the filled tributary. Site A is in the mangroves. Site 3 is upstream from the filled area taken as a control. On the last two occasions samples have been taken at or immediately below the spring at site 2.

1.2.5 Subsurface Investigations - Landfill Investigation

Three boreholes were dug within the bounds of the landfill in January 1996. All three bores showed a depth of fill ranging between 7.5m (at the top of the bank) to 6.0m depth (at the other two bores). They all contained a mix of refuse and clay, with quite a high content of rubbish in places. No abnormal gas readings were measured.

Each bore showed that Waitemata group underlay the fill.

The groundwater table was intercepted in each bore at 1.5 to 2m depths. Piezometers were installed in each bore.

Topsoil of depths 0.6m and 1.3m was found in two of the bores. Topsoil was not recorded as being found in the last bore.

Groundwater samples were taken from all three bores in March 1996.

1.2.6 *Previous Groundwater Investigations*

There is some specific background information for this site. To investigate problems with the shallow depth of the groundwater table and possible groundwater contamination arising from the graves a groundwater contamination investigation was undertaken in November 1994 by Pattle Delamore Partners. Some of the findings of their investigation are summarised here with the kind permission of the Manager of Manukau Memorial Gardens. We should note that Pattle Delamore did not seem to be aware that the site contained a landfill and their investigations did not include the landfill area.

During that investigation seven bores were dug on the site - one to the north, two to the east and four to the south of the landfill. Pattle Delamore acknowledges that insufficient bores were dug to clearly establish groundwater contours and its flow directions on the site. The pattern of groundwater is not simple and the results could be interpreted as being the result of perched groundwater or being due to groundwater flowing to former and still existing stream tributaries. It could be expected though that the general direction of groundwater would be to the east towards the stream.

The samples taken at the Pattle Delamore bores 2 and 3 are reasonably representative of the background groundwater quality.

The analytes tested both in our investigation and in the previous investigation were ammonia, nitrate and conductivity.

Ammonia in the landfill was in the range 70 - 130 mg/l, whereas the background groundwater showed levels of approximately 0.05 mg/l.

Nitrate measured in the landfill was less than 0.1 mg/l, whereas it was measured as 15 g/l in the background water. This disparity could possibly be due to the fact that the landfill groundwater was not analysed soon enough.

The overall picture is that the background groundwater, upstream of the influence of the landfill (and/or the graves - which Pattle Delamore separately



conclude are not having a significant impact) does not contain high concentrations of contaminants.

1.2.7 **Results and Conclusions**

The surface water quality results showed no measurable contamination above background levels.

The groundwater analyses from the bores in the landfill area show that the average concentration of selected leachate indicators is 20.94% of the concentration of those indicators in a typical landfill leachate.

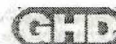
Again, the indicative data obtained for the site in relation to the levels of environmental contaminants, were found to be below or close to the detection limits of the various parameters measured.

1.3 **Ngati Otara (Otara Park)**

Site Name	Ngati Otara
Filltype	Household
Estimated Fill Volume (m ³)	24000
Estimated Fill Area (ha)	0.6
Estimated Average Depth (m)	4
Road Location	Alexander Crescent, Ngati Otara Park
Suburb	Otara
Adjacent Watercourse	Otara Lake
Open	1967
Close	1969
Underlying Geology	Inter-tidal mud and thick, fine and bedded ash
Legal Description	Pt Allot 520 Manurewa PSH (S0 53719)
Leachate Strength (%)	14.80
Condition Index Value	2162

1.3.1 **Location and Description**

This site consists of a filled former inlet of the Otara Lake located inside the Otara Park in the area bordered by the Otara Lake, Otara Rd and Alexander Crescent. The site is now a recreational park consisting of passive recreation areas surrounding and to the west of a number of playing fields.



The confirmed filled area is a reclaimed tributary of the Otara Creek at the western end of the park. The tributary originated from around the location of the present marae. The front face of the fill falls onto a still existing tributary of the lake near the power station.

The site is largely flat and slightly lower than the surrounding ground. The land is generally flat. There are reasonably steep banks falling down to the Otara Lake to the north and the small tributary / inlet to the west.

The surface is a well-maintained grass surface with scattered trees over those areas not on the playing fields. None of the vegetation shows any signs of distress except for one tree at

the western edge of the fill area that is dying. There are signs of surface settlement causing poor drainage and probable ponding on a portion of the reclaimed area.

There are rusty springs at the edge of the tidal mudflats on the front face of the fill which are most likely carrying discharges from the buried refuse (they are dry during summer). Due to the presence of these springs the site is classified as discharging to water rather than discharging to ground.

Access onto the site can be gained through Otara Road, which extends on to the park to the east of the landfill area.

1.3.2 History

No written records of fill quantities or compositions were kept. Verbal reports from council staff and members of the public confirm the location of the site, which was operated by council as a municipal refuse dump. The landfill reclaimed a former branch of an inlet of the Otara Lake inlet on the western side of the park. Aerial photographs taken prior to the reclamation confirm the extent of filling. The remainder of the inlet has not been filled. All household and commercial refuse types were accepted for filling.

Apart from the reclaimed inlet it is not certain whether other sites in the park area were filled. It has been reported that the various original hills and gullies all over the present Ngati Otara Park were filled with cleanfill, rubbish, hardfill etc. However the verbal reports on the existence and location of these sites are conflicting. If other sites have been filled with refuse they are probably minor compared to the volume of fill contained in the main fill area.

1.3.3 Surface Water and Ecology

The Otara Lake is manmade and was formed by damming the Otara Creek close to where it joined the Tamaki River. The water in the lake is saline and tidal.

The 'Otara Lake Water Quality Study' by Manukau Consultants gives the following breakdown of zoning in the Otara Lake catchment.

Table 11: Land Uses in Catchment of Otara Lake

Land Use Zones	Area (ha)	%
Residential	812	23.0
Business	436	12.0
Future Development	546	16.0
Rural	992	28.0
Roads	286	8.0
Public Open Spaces	200	6.0
Miscellaneous	246	7.0

The urban areas are predominantly residential with significant commercial and industrial development. Urban stormwater runoff, sewerage overflows and/or illegal links to stormwater pipes have further influence on the lake water quality characteristics. General water quality results indicate that the lake is substantially polluted regardless of any influence of the landfill. The lake edge is heavily silted and muddy. The lake carries high levels of suspended particles, micro-organisms and metal pollutants.

The degraded water quality in the Otara Lake makes swimming and fishing for food unsafe. However the area is the subject of water quality initiatives by the MCC, ARC and ECNZ with intention of making the area suitable for contact water sports.

Some finned fish are still observable but the diversity and population of aquatic life is far less than that which long term residents reported to have existed prior to the development of the catchment. Long term residents reported the waterway to have contained plentiful fish such as mullet and was a popular swimming location. Riverbanks and bottoms were firmer and lack the silt and mud, which now cover the tidal flats. Fish from the Otara Creek are unlikely to be safe for consumption.

There are no freshwater streams crossing the park.

1.3.4 **Drains**

Flows in the extensive network of stormwater drains underneath the northern playing field have been sampled due to the possibility that they may be collecting seepage from the various filled sites.

The top or eastern end of the known fill area is cut by a stormwater culvert, which joins two other culverts running out from beneath the marae grounds.

Sampling from the manhole where these three culverts meet has shown evidence of sewerage connections into the stormwater system.

A network of subsoil drains underlies the sports grounds between the known fill area and the extension of Otara Rd going into the park.

1.3.5 Surrounds

There are single storey marae buildings within the marae grounds just to the southeast of the known fill area. There is residential housing within fifty metres of the southern edge of the known fill area.

The surrounding area is generally flat and used for a mix of residential housing, commercial and industrial uses. Hillary College is within the bounds of Otara Park and Clydemore School and Bairds Intermediate are within a couple of hundred metres of the site. The Otara shopping centre and Manukau Polytechnic are beyond that. To the west is ECNZ's Otahuhu gas turbine power station, which operates during peak load periods. The purpose of the dam, which forms the Otara Lake, is to impound cooling water for the power station. The southern motorway is just beyond the power station. The Hills Rd site is just upstream to the southeast.

1.3.6 Water Sampling

The main filling area was in the former gully running between sites 3 and 5 whose extents are shown on the sampling map. Sites 3 & 5 would be expected to have the greatest probability of showing any contamination. Site 3 is a spring on the front face of this filled area and should provide direct information on the leachate. However as site 3 is in the tidal mudflat, the saline influence on samples taken from that location may confuse the characterisation of water quality / leachate strength.

Site 5 is a manhole to a stormwater culvert built within or very close to the filled area. There is a distinct vile smell in the manhole at site 5 whose chamber walls are heavily encrusted with rusty deposits at the joints. The joints constantly drip with inflowing seepage. This possibly suggests that water is entering the chamber loaded with dissolved metals, which become deposited as oxides on the manhole walls. This may mean that leachate is entering into the culvert here. Site 5 is unlikely to have been influenced by seawater.

Sampling locations 2 and 4 also sample stormwater culverts. Site 2 is shown in the map in the stormwater outfall to the Otara Creek. This outfall is in a tidal area. Though none of the culverts which feed these sites pass through or underneath the known filled area they have been sampled due to the uncertain location of fill on the site.

Site 6 samples a rivulet close to the tidal area in the Otara creek bank. The rivulet starts from a spring on the side of the slope away from the sports ground. It was sampled in case it contained any leachate discharges. Station 7 is in the Otara Creek at the end of Alexander Rd.

1.3.7 Subsurface Investigations

Three bores were dug on the site along the former inlet. The deepest fill (6.5m) was found at the higher end of the old inlet where the ground is higher. 1.5m of fill was found in the middle bore and 2.5m was found in the bore closest to the existing inlet. The results

suggest that the second bore be probably placed in the side rather than the middle of the former gully.

A mixture of refuse, organic materials and clay was found in all of the bores. Gas levels in 37% LEL were measured in the second bore but no abnormal readings were measured in the other bores.

The groundwater table was intercepted in all of the bores between 1 and 2m depth. Piezometers were installed in all of the bores. In the second borehole the groundwater was found to be below the fill interface.

The topsoil depth was around 0.6m in the top two bores, but there was none at all in the lower bore.

The bore furthest from the estuary was found to be underlain by estuarine clay. The other two bores were found to be underlain by Waitemata group materials. This suggests that Waitemata group underlies the whole area. It may be that only the first bore was actually placed in the centre of the old stream channel.

1.3.8 Consultations

A letter drop to neighbouring residents took place in December 1994 to inform them what the investigation is for and to request information. No responses were received.

A report to the Otara Ward community board March meeting and a subsequent article in the Manukau Courier resulted in several callers providing historical information about this site. There have been several responses but none indicated any environmental problems.

1.3.9 Results and Conclusions

The surface water quality monitoring results indicated a low level of contamination at the site. Combined results of groundwater samples and



sample from the spring at the front face of the fill showed that the average concentration of selected leachate indicators is 14.80% of the concentration of those indicators in a typical landfill leachate.

The indicative data obtained for the site in relation to the levels of environmental contaminants, were found to be below or close to the detection limits of the various parameters measured.

1.4 Miro Road (Te Puea Marae)

Site Name	Miro Rd
Filltype	Mixed
Estimated Fill Volume (m ³)	30000
Estimated Fill Area (ha)	2
Estimated Average Depth (m)	1.5 ha
Road Location	NW Cnr Miro And Mahunga, within Te Puea Marae
Suburb	Mangere Bridge
Adjacent Watercourse	Manukau harbour
Open	1982
Close	1987
Underlying Geology	Inter-tidal mud containing some sand, silt and shell
Legal Description	Pt Sec 1 Blk V Otahuhu SD (SO 56622)
Leachate Strength (%)	4.46 (extreme result excluded)
Condition Index Value	916

1.4.1 Location and Description

Miro Rd, Mahunga Drive and the Mt Roskill - Mangere motorway, enclose the site.

The site falls from the motorway overbridge in the northwestern corner to the intersection of Mahunga Drive and Miro Rd at the southeast. There is a sharp bank on the western side of the site falls towards the motorway and there are mild slopes in all other directions.

The fill surface was never adequately sealed and contoured. Irregularities on the surface impede surface water runoff. The presence of obstacles on the ground such as concrete blocks, stones and metal make mowing and general

maintenance difficult. The exposure of the obstacles is due to inadequate surface cover. The site is at present unusable for even passive recreation.

The vegetation on the site consists of thick grass and weeds. A number of trees have been planted around the fringes of the site adjacent to Mahunga Drive.

The Marae trustees are considering plans to build a major complex for health and community purposes. Foundation conditions will probably restrict potentially suitable areas for building development to the southeastern half of the site.

The site is almost directly adjacent to the Mangere interchange off the motorway and is highly visible from the motorway, Mahunga Drive off-ramp and Mahunga Drive itself.

1.4.2 Reported History

The original foreshore ran in a jagged line from halfway along the western boundary to cross approximately halfway along the southern boundary. All other areas are reclaimed lands and fill probably overlies original ground near the marae buildings. This site was filled in as a reclamation of the former impounded marine enclosure created by the construction of Mahunga Drive.

The site was owned by the MCC when it was operated as a fill. Since the completion of filling the site has been vested in the marae trustees. Council undertook to hand over the site in a suitable state.

No written records of fill types or quantities were kept but verbal reports from council staff and members of the public suggest that the materials received at the site were cleanfill, inorganic refuse, street sweepings and cesspits. There was some illegal dumping of household refuse.

1.4.3 Surface Water and Ecology

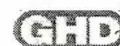
There are no surface creeks or well-defined drainage lines on the site.

Mahunga Drive borders the Manukau harbour. Tidal water comes up stormwater culverts on site and permeates the filled areas. The water quality of the Manukau Harbour is impaired but the ARC has initiatives to improve this.

The present state of water quality in the near Manukau Harbour limits recreational uses of the harbour. Swimming, fishing, food harvesting and other recreational activities may be safer in the long term if the Arc efforts are successful. Any improvements in water quality though, are likely to occur after or towards the end of this sites potential leachate production period.

The near by Manukau Harbour accepts waste discharges from a multitude of other industrial and waste disposal sites.

There is a small mangrove community along the seawall where the stormwater pipe which run underneath the site discharge.



1.4.4 **Drains**

Two 900 diameter stormwater underground culverts traverse the site falling towards Mahunga Drive from the motorway. A 750 diameter third culvert crosses the south-east corner of the site east of the marae buildings from Miro Rd and exiting onto Mahunga Drive. There are understood to be a number of private drainage connections in this same area. Two stormwater cut-off trenches have recently been installed adjacent to the Marae fence and drain into one of the culverts.

1.4.5 **Surrounds**

The site backs onto the Mangere-Mt Roskill Motorway to the west. On the eastern side of the motorway the land use is predominantly industrial and this area extends to the south along Mahunga Drive. On the other side land use is residential but the motorway forms a barrier.

The marae operates a community centre presently on the other side of Miro Rd from the landfill site. The centre includes old people's homes and a youth training centre. A kohanga recreational centre is presently being established. The marae trustees also have plans to develop a health centre. The health centre will possibly be established on or directly adjacent to the fill area.

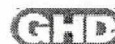
There are single storey marae buildings at the Southwest corner of the block on which the marae sits. As discussed above there are further marae buildings on the other side of Miro Rd. Next door to the marae buildings on the opposite corner of Miro and Mahunga Rds is a large factory warehouse.

A description of the other pollutant sources around the Manukau Harbour is given in the site report for Harania Ave.

1.4.6 **Water Sampling**

The manholes in stormwater culverts and tidal pools at the culvert outlets have been used as sampling sites. These would show contamination if waters contaminated with leachate seeped into the stormwater culvert. There was evidence of seepage occurring at two of the manhole chambers. Apart from the downstream locations at the outlets and the control samples in the sea all the samples were taken from the manhole chambers.

Sites 1 and 4 are the upstream control and downstream sites respectively on the northernmost culvert on the site. Sites 2 and 3 are between them. During high tides the seawater level came up at least as far as site 3 but was never observed at site 2.



In the middle culvert there are two sites, denoted 5 and 6. Site 6 is the culvert outlet. A soakage trench constructed parallel to the marae fence, to prevent surface water flooding the marae grounds, has been connected to the manhole at site 5. This should increase the possibility of leachate entering this culvert though only if it gets to the subsoil drain which is not guaranteed as it is quite shallow and set back from the known fill area.

The southernmost culvert line is sampled at site 7 within the filled area and site 8 downstream at the outlet. Site 9 samples a culvert line running over non-landfill site but through the factory site adjacent to the marae. Sites downstream of the filled area e. g. 4,6,8,9 are below tide levels and so will have marine influence. Two sites just offshore, sites 10 and 11, are intended to provide background analyte levels.

1.4.7 **Subsurface Investigations**

A preliminary soils investigation was undertaken in April 1995 to confirm our understanding of the fill materials present at the site. Though this investigation provided some useful background information it was considered too limited in scope to provide sufficient information for background assessment.

Three boreholes were drilled in August 1995 for the purpose of installing piezometers for groundwater monitoring.

In May / June 1996 an extensive geotechnical investigation was undertaken. The investigation showed that refuse is concentrated mostly in the top north-western half of the site and along the Mahunga Drive boundary.

1.4.8 **Results and Conclusions**

Only the bore samples have been used in the calculation of the leachate strength. The average concentration of selected leachate indicators is 4.46% of the concentration of those indicators in a typical landfill leachate. This however does exclude some of the extreme results, which were thought to have been affected by the presence of sediment in the samples. If the extreme results are included then the leachate strength is 20.17%.

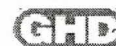
Recently the site has been capped and grassed.

The indicative data obtained for the site in relation to the levels of environmental contaminants, were found to be below or close to the detection limits of the various parameters measured.

1.5 **Dale Crescent**

Site Name

Dale Crescent



Filltype	Inorganic
Estimated Fill Volume (m ³)	15000
Estimated Fill Area (ha)	1
Estimated Average Depth (m)	1.5
Road Location	Between Waipuna Motorway and Dale Crescent
Suburb	Pakuranga
Adjacent Watercourse	stormwater discharges to tributary of Tamaki River other side of motorway
Open	unknown
Close	unknown
Legal Description	Sec 1 SO 52269
Leachate Strength (%)	17.56
Condition Index Value	635

1.5.1 Location and Description

The site is located just at the western end of the Waipuna Bridge in the flat open space area bound by the residential properties on Dale Crescent and the embankment of the Pakuranga - Panmure motorway. The site was apparently created at the time of the motorway construction by filling in the previous swampy area.

1.5.2 Surface Water and Ecology

The site is approximately 100m from the Tamaki River at its closest point. This is just downstream of the confluence of the Pakuranga and Otahuhu Creeks. The catchment to the Tamaki River contains principally residential and commercial / industrial areas. Most of the few remaining rural areas are currently being subdivided and developed. The estuary is completely tidal at this point.

Aquatic fauna is scarce and does not display species diversity. This is characteristic of the ecosystems in degraded urban waterways.

1.5.3 Drains

Stormwater lines run to the east and west, draining cesspits in the middle of the site adjacent to the footpath. The drains are at the east and west ends running away from the middle of the site. A major 1060 diameter Watercare water



supply pipe crosses the northern part of the site. Bulk power transmission lines also run overhead.

1.5.4 Surrounds

The properties sharing the northern boundary of the site, and those to the south of the site beyond the motorway are residential. The Pakuranga shopping centre is located to the east. Pakuranga Intermediate is within five hundred metres to the east. The Riverina School is several hundred metres to the west and Anchorage Park School is several hundred metres further to the south.

1.5.5 Subsurface Investigations

Four bores were drilled in a rough line along the site. All bores showed a mix of gravel, silt and clay fill of depths between 1 and 2.5m. It appears likely that organic materials were not imported onto the site.

The water table was intercepted at 2 to 2.5m depths in all but the easternmost bore where it was not found by 3m depth. The southernmost bore, closest to the motorway showed that Waitemata group materials underlay the fill. In the other bores marine / estuarine deposits were found.

In two bores where marine sediments were found, the fill also contained plant fragments. It is likely that the plant fragments are the remnants of vegetation on the site prior to the placement of the fill. The groundwater table was also intercepted in these two bores and the measured gas levels were 75% and 90% LEL. In the latter there was also a bubbling noise. A piezometer was installed in this bore.

In the other two bores the measured gas levels were around 35% LEL. Groundwater was found in one of these bores. It may be that the gas levels occur as a result of decomposition of the plant fragments.

In the three bores where the groundwater table was found it was between 2 and 2.5m deep. Topsoil was found in one bore to a depth of 0.1m, but was not found elsewhere.

1.5.6 Results and Conclusions

The average concentration of selected leachate indicators is 17.56% of the concentration of those indicators in a typical landfill leachate. The level of ammonia at this site is also higher than the level at most of the other sites.

This level of contamination is quite surprising as no refuse was found during drilling and the bores on the site covered the site reasonably well. However the bore logs do indicate that the fill was not entirely clean clay. This indicates in

itself that the fill was not entirely taken from the surplus of earthworks operations.

Another possibility is that the level of contamination is due to rotting plant fragments. These were shown to be present during drilling. The fill may have been placed over the site without first removing the organic material beneath it.

Overall, the indicative data obtained for the site in relation to the levels of environmental contaminants, were found to be below or close to the detection limits of the various parameters measured.

1.6 Great South Road

Site Name	Great South Rd
Filltype	Hazardous
Estimated Fill Volume (m3)	15000
Estimated Fill Area (ha)	0.3
Estimated Average Depth (m)	5
Road Location	Great South Rd, South Bank/West Side on River
Suburb	Otahuhu
Adjacent Watercourse	Tamaki River
Open	1977
Close	1982
Underlying Geology	Inter-tidal mud and sedimentary materials of the Tauranga Group
Legal Description	Allot 523 & 540 Manurewa PSH (SO 55438) T.B.A.
Leachate Strength (%)	7.96
Condition Index Value	545

1.6.1 Location, Description and History

The site is on the southern bank of the Tamaki River on the western side of Great South Rd. The reserve, which includes the site, extends to the Manukau end of the Tamaki River Bridge. The filled area is less than 50m from Great South Rd.

Filling took place in a former inlet / tributary of the river in two separate areas. The back end of the inlet has been filled and a small bay has been formed on the riverbank. Filling has also taken place on one side of this bay. The two



Permission was gained to fill the land with the proviso that the completed reclamation would be vested in Manukau City Council.

We have found very little direct correspondence between Manukau City Council and the then Wellcome NZ Ltd. However we have been able to establish that Manukau City Council was contracted by Wellcome NZ Ltd to fill in the land however it is not clear whether this agreement was reached after the original decision to vest the land in Manukau City Council.

It was found when the fill was surveyed that the amount of filling that had been undertaken exceeded the amount set down in the reclamation permit. A second permit was issued to regularise the situation. Anecdotal reports from MCC staff indicated that the arrangement between Wellcome and the MCC involved a cost sharing exercise for the installation of culverts and both parties would have access to the site to dispose of hardfill.

The site was supposed to have been a hardfill site. However there has been some illegal household and commercial dumping. A few adjoining garages have been observed to allow wash-down effluents to run onto the site and this practice is thought to still continue. Several car wrecks have been dumped on the fringes of the site.

1.6.3 Surrounds

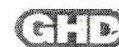
The site is in the middle of the Otahuhu / Papatoetoe industrial area. Low areas predominantly surround the site with very slight fall towards the Tamaki River.

The site is part of the esplanade reserve for the Tamaki River. To the north and east the property boundaries extend around to the Great South Road Bridge crossing the Tamaki River. The property continues upstream. To the south and east the site is bounded by privately owned industrial properties.

The surrounding land on the southern bank is used for light industry such as workshops and warehouses. It is possible that yard effluents from these adjacent businesses are occasionally discharged onto the site by either stormwater drains or overland flow. Any industry in the catchment of the stormwater culverts could contribute to contaminant discharge onto the site near the stormwater outlets. Urban and industrial land uses in the catchment no doubt contribute to the degradation of water quality in the Tamaki River at the site.

1.6.4 Water Sampling

Sampling site 1 is in a spring in the inter-tidal zone and site 2 is located under the mangrove stands. They are both close to the toe of the filled area. As site 1 is located above the tide level at low tide it is only intermittently flushed. Site 2 is lower and will receive continuous tidal flushing. Flushing at both sites is due to tidal action rather than direct river flow. As both sites are at the bottom of a bank it is possible that contaminants from off the property could reach the



location where the samples are taken from. These could affect the levels of contaminants found in samples taken from the site.

1.6.5 Subsurface Investigations

The two halves of the site have been designated independently in the bore logs as 'Great South Rd' and 'Glaxo Wellcome', the latter being that part of the site within the bounds of the Glaxo Wellcome site. Gas levels of 10% LEL were recorded in the bore above marine mud.

In the 'Great South Rd' half two bores were dug. The depth of fill was 4.5m and 5m for the two bores. The groundwater table was intercepted just above the fill / natural ground interface. The fill contained an assortment of refuse. Marine mud was found beneath the fill in one bore, while Waitemata group materials underlay the fill at the other bore. The water level was intercepted at or just above the fill / natural ground interface. One bore showed a depth of 0.8m topsoil whereas the other showed none.

In the 'Glaxo Wellcome' half two further bores were drilled. Each bore showed an assortment of clay fills and rubbish. The groundwater table was not installed at either bore however it was high tide at the time of drilling. The fact that the groundwater table was not intercepted and that marine mud was not found suggests that these bores were not installed in the centre of the old estuary. There was an average of 0.6m topsoil in this half of the site.

Piezometers were installed in all four bores. However two of the bores have subsequently been buried under tyres. It is necessary to contact neighbouring landowners to have the tyres removed.

More recently further investigations have been carried out to ascertain whether there were any significant levels of organic pollutants of environmental concern at the site. Two borehole water samples were taken and analysed for a wide range of known environmental contaminants. The results of the analysis are attached to this report as Appendix D.

No significant levels of any of the organic pollutants were detected in the samples.

1.6.6 Results and Conclusions

The surface water monitoring results indicated a high degree of contamination on one occasion. The concentrations (of analytes) found are not necessarily in a pattern characteristic of landfill leachates (high levels of zinc have been found but little else). It is possible that this contamination was due to wash-downs from surrounding properties. Otherwise the results have shown low levels of contamination.



The average concentration of selected leachate indicators is 7.96% of the concentration of those indicators in a typical landfill leachate. No significant levels of any of the organic pollutants were detected in the leachate samples.

1.7 Robert Allan Road

Site Name	Robert Allan
Filltype	Mixed
Estimated Fill Volume (m3)	5600
Estimated Fill Area (ha)	0.25
Estimated Average Depth (m)	2.25
Road Location	off Robert Allan Way, almost opposite Nan Pl.
Suburb	Pakuranga
Adjacent Watercourse	unnamed (to Pakuranga Creek)
Open	unknown
Close	unknown
Underlying Geology	Soft mud and silt. Moderately weathered Tauranga group silt and clay close by
Legal Description	Allot 386 Pakuranga PSH (SO 49436)
Leachate Strength (%)	8.55
Condition Index Value	199

1.7.1 Location and Description

The site is an empty lot between residential properties in suburban Pakuranga. It borders onto a tributary of the Pakuranga Creek. The site is several hundred metres downstream of the Elm

The Park site, several hundred metres upstream of the Riverhills School site and is almost immediately opposite the Ennis Ave site.

MCC maps suggest that the site consist of the reclamation of a former inlet of the creek running down the northern half of the site. No other record of the site is documented and the fill type was not known prior to drilling.

The site surface is uneven and has a boggy, unkempt appearance even in summer suggesting that it does not drain well. There is a row of tall pine trees running down the northern boundary of the site.

The site borders onto a tributary of the Pakuranga Creek, which is itself, a tributary of the Tamaki River. The catchment to the creek at this side contains almost entirely residential areas.

The estuary is tidal at this point.

The aquatic ecology appears barren on observation, as is characteristic of most urban rivers.

There is a 600 diameter stormwater drain running parallel to the filled area along the length of the site before discharging into the creek.

1.7.2 Surrounds

The Pakuranga Creek tributary flows south past the site. The area around the site is all residential. The Elm Park and Riverhills Schools are within several hundred metres north and south respectively but are on the other side of the creek.

The topography of the surrounding land is moderately hilly.

1.7.3 Subsurface Investigations

Four bores were dug in a rough line along the site, up to three metres deep. The depth of fill encountered was around three metres, with greater depths being found at the back of the site away from the creek where the ground is slightly higher.

The water table was encountered at about 1.5m depth in every bore except the bore closest to the creek, which was drilled at low tide. Piezometers were installed in the two bores in the middle of the site.

Some organic debris and plant fragments were found in one of the bores. Otherwise the fill was all clay. Gas levels ranging from 15% to 35% LEL were found in the bores.

Topsoil depth was found to a depth of 0.3m in one of the bores. It was not found elsewhere. The bores show that Waitemata group materials underlie the site though marine sand was found in one of the bores.

1.7.4 Results and Conclusions

The average concentration of selected leachate indicators is 8.55% of the concentration of those indicators in a typical landfill leachate.

The amount of gas measured could be due to the decomposition of plant matter that was not removed prior to the placement of the fill.



The indicative data obtained for the site in relation to the levels of environmental contaminants, were found to be below or close to the detection limits of the various parameters measured.

1.8 Harania Ave

Site Name	Harania Ave
Filltype	Mixed
Estimated Fill Volume (M3)	6000
Estimated Fill Area (ha)	0.3
Estimated Average Depth (M)	2
Road Location	Harania Ave Reserve Opposite Tinkler Ave
Suburb	Favona
Adjacent Watercourse	Manukau Harbour
Open	unknown
Close	unknown
Underlying Geology	
Legal Description	Lot 61 DP 61809
Leachate Strength (%)	2.39
Condition Index Value	58

1.8.1 Location and Description

The site is in Harania Park. The park is around an estuarine tributary of the Harania Inlet. A tributary of the creek appears on many maps to cut westward through Harania Ave but is actually piped through a 900 diameter culvert that runs through the filled area before discharging into the estuary. The main body of the creek goes south past the site. The site is now a recreational reserve off Harania Ave opposite Tinkler Ave. It has a well maintained grass surface.

No record of the site is documented and information is from the memories of long serving council staff. The extent of filling on this site was uncertain, but has largely being confirmed by exploratory drilling.

Filling took place in the former extension of the inlet which ran towards Harania Rd and Tinkler Ave. As described above, the water course which ran through the former inlet is now piped, and the culvert discharges into the inlet. It may also have taken place along the existing stream edge. It is thought to have taken all non-household types of refuse.



Fill also took place along the front of the site on the edge of the creek.

The creek itself is freshwater at the top, southern end of the site. It becomes saline at the bottom end of the site. The creek is choked by plantlife along the length of the site - with water weeds upstream and mangrove stands downstream. The water in the creek is slow moving - the water in it is dark from silt and a high density of plant material.

The site is flat with a slight fall towards the estuary. It is prone to water logging along the depression where the old creek used to be.

The water quality of the Harania Inlet appears polluted and heavily silted.

Aside from the 900 diameter stormwater culvert the site is crossed by 230 diameter sewer lines running north to south just to the western edge of the estuary. There are two further stormwater outlets probably beyond the extent of filling at the northern end of the site.

The surrounding land to the north, east and south is predominantly residential. The Favona Primary school is a couple of blocks from the site along Wakefield Rd which runs onto Harania Ave. The Mangere hospital and training centre grounds are on the other side of the stream.

The Manukau Harbour is fairly polluted and there is some heavy industry in the catchment area of the Harania Inlet including the Pacific steel plant and its adjacent private landfill. This landfill takes waste processing materials from the plant. The cover at this site appears to consist of a dusty silty material. The near Manukau Harbour is also bordered by several large Auckland City Council and Auckland Regional Services Trust former landfills, the former Westfield freezing works and the now largely abandoned Station Rd railway workshops among other possible major impact sources. The harbour is noted to suffer adversely from poor (at least historically) silt control practices and from the effects of urban stormwater runoff.

The heavy industry along the shorelines of the inlet, other landfilling and reclamation activities both ongoing and historical along the shoreline of the inlet are all possible other pollutant sources. The adverse water quality of the inlet and the Manukau harbour in general restricts recreational uses of the water in the area. While the thick mangroves will form a barrier preventing silt from the inlet from travelling upstream, other contaminants could be expected to flush back up the creek.

The site is underlain, most probably , by intertidal mud containing some sand, silt and shell. The site could be underlain by sedimentary materials of the Tauranga group.

1.8.2 **Water Sampling**

Sites 1 to 4 are all in the estuary. As mentioned above it is not certain at present whether filling took place along the creek past where it turns south (moving upstream) at the northern end of the site. Even if it did take place the tidal action which extends at least up to between sites 2 and 3 where the



mangroves begin may result in flushing and mixing of the area and thus may blur any possible difference between sites 2 , 3 and 4 by either dilution or by propagating contamination upstream. This possibility has been mitigated to some extent by taking samples at or near low tide. Site 1 is beyond the mangroves upstream and should be clear of any saline influence. However because it is not saline site 1 is not necessarily a good control of the downstream sites. Thus the detection of contamination at sites 1, 2 and 3 would not necessarily be due to the landfill. The non- detection of contamination downstream would however show that the landfill is not affecting the marine environment.

Sites 5 and 6 are in the stormwater culvert running west to east from near Tinkler Ave. These sampling sites would only detect leachate if it can enter the culvert i. e. non contamination of leachate in the culvert does not mean it does not exist, only that it cannot be detected in the culvert.

1.8.3 Subsurface Investigations

Five bores were dug on the site.

Four boreholes were dug along or next to the old stream bed which used to flow from near the present Tinkler Ave. Up to 2m of clay fill was found in these four bores.

The fifth bore was located on the existing stream, bank. This bore showed 1.5m of clay fill with some wood fragments at the bottom of this layer. Below this there was another 1.3m of clay with wood fragments.

The groundwater table was intercepted at 1.5 to 2m in all bores. Three piezometers were installed. No abnormal gas readings were measured in any of the bores.

1.8.4 Results and Conclusions

The water quality results indicated a moderate level of contamination, though this cannot necessarily be attribute to the landfill. The groundwater tests however showed that the average concentration of selected leachate indicators is 2.39% of the concentration of those indicators in a typical landfill leachate. This indicates that the contaminant levels from the landfill itself are very low.

Furthermore, the overall indicative data obtained for the site in relation to the levels of environmental contaminants, were found to be below or close to the detection limits of the various parameters measured