

Cremer & Warner Ltd

**PRELIMINARY
CONTAMINATED SITE
INVESTIGATION
CONTRACT CHEMICALS
LTD., KNOWSLEY**

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PRELIMINARY CONTAMINATED SITE INVESTIGATION

CONTRACT CHEMICALS LTD, KNOWSLEY

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CREMER & WARNER

C3971/1

Report No 93169

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1.0 INTRODUCTION

Cremer and Warner (C&W) was commissioned by Contract Chemicals Ltd (CC) to undertake a site investigation at their site at Knowsley, Prescott.

The scope of the work was based on Proposal Number P4246, dated 10 December 1992 and revised in subsequent telephone calls with Mr P Kinley (CC).

1.1 Aim of the Study

The aim of this study was to conduct a preliminary appraisal of possible ground contamination conditions in an area which comprises land in the ownership of CC, an unused field owned by Knowsley Borough Council (KBC) and land owned by McGregor Cory Ltd (MC)

KBC required certain conditions to be met prior to allowing C&W access to KBC land. The conditions were unacceptable to CC and consequently no investigation work was undertaken on KBC land.

2.0 BACKGROUND TO THE SITE INVESTIGATION

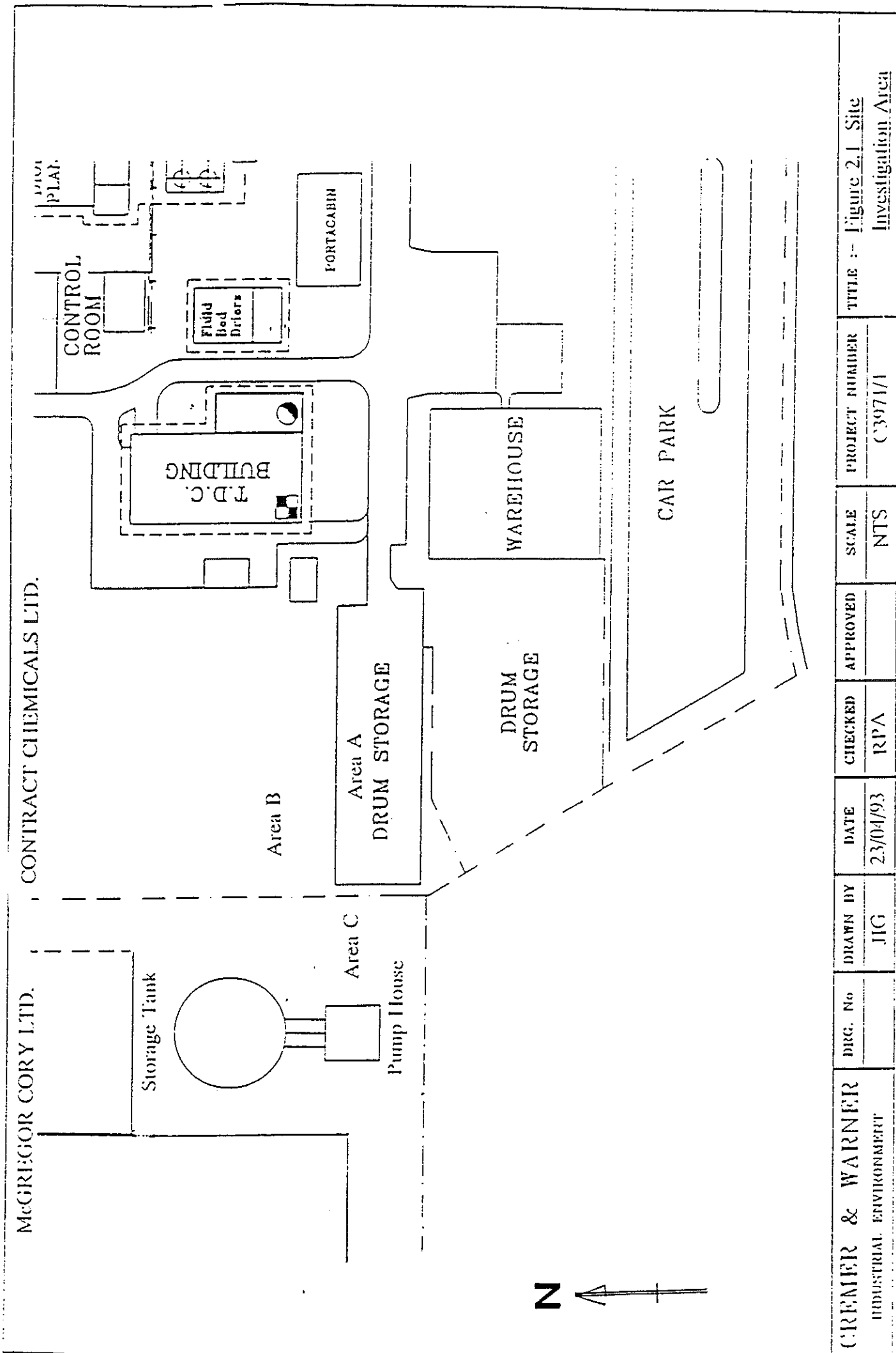
2.1 Site Geography and Description

The area investigated occupies approximately 0.2ha along the boundary of the CC and MC sites in Knowsley Industrial Park near Prescott. The area investigated is illustrated in Figure 2.1.

The western side of the CC site is used as a chemical storage area where waste products have been stored since 1982. A section of the storage area has recently been concreted over (referred to as Area A in Figure 2.1) with an area of approximately 0.2ha remaining with aggregate hardstanding (Area B). The MC site lies to the west of the storage area separated by a boundary fence. An embankment runs along the boundary with a downward gradient running from the CC storage area to the MC site. The area of investigation on MC land is referred to as Area C in Figure 2.1.

2.2 Site Operations

CC produce chemical intermediates to contract. Friedel-Crafts reactions are performed to alkylate aromatic hydrocarbons. Two proprietary compounds are produced on site with the trade name "Permanax" and are benzene dialkyl amines in character. Raw materials used in the processes operated include benzophenone, acetic acid and benzoyl chloride.



3.0 SITE INVESTIGATION

3.1 Sampling Strategy and Methods

Guidance on the investigation of contaminated land is issued in the British Standard Institution document DD175, entitled "Code of practice for the identification of potentially contaminated land and its investigation". However, DD175 is a ground investigation specification employed when land is to be redeveloped and the aim of this preliminary investigation is to determine whether contamination has occurred rather than enable the site to be redeveloped. Also DD175 does not provide guidance on site investigation requirements on sites as small as the area under investigation in this study.

Therefore, the following sampling program was devised to enable the maximum level of information to be obtained within the financial constraints of the study.

Sub surface samples were collected from a total of nine locations aligned in rows parallel to the site boundary between MC and CC. Samples collected from each row were combined into one composite sample for analysis. The rows were positioned at the following distances from the boundary fence:-

CC land

Row 1	15m	(sample reference TP3,4)
Row 2	3m	(sample reference TP1,2)

MC land

Row 3	1.5m	(sample reference TP7,8)
Row 4	5m	(sample reference TP5,6)

Following this protocol, an indication of contaminant concentration variations with distance on either side of the site perimeter could be attained.

A further two additional sampling locations for boreholes were located, one on CC property, the other on MC land.

All sampling locations are illustrated in Figure 3.1

3.1.1 Trial Pits

Eight trial pits (as detailed above) were excavated to depths of up to 0.8m using a back-hoe excavator on the 19 March 1993. The trial pits were not extended beyond these depths to prevent potential damage to unidentified

services and to prevent potential contamination in upper soil strata penetrating further through the soil column. The location of trial pits were restricted by three electric cables whose approximate locations were identified by a cable detector.

Samples were collected at depths of 0.1m, 0.3m and 0.5m and subsequently composited with other samples from locations equidistant from the site boundary. All samples were collected in 0.5 litre, airtight glass jars and transferred to the laboratory in cool boxes where they were refrigerated prior to analysis.

3.1.2 Boreholes

To monitor groundwater conditions beneath the investigation area, two boreholes were drilled one on either side of the perimeter fence between CC and MC land to depths of 3.5m on 19 March 1993. The boreholes were instrumented with 50mm slotted monitoring screens with a geotextile wrap. To prevent contamination of underlying strata, the boreholes were instrumented with slotted monitoring pipe, in a pea gravel annulus, to a depth of only 2m and the remaining void to the mudstone sealed with bentonite grout.

A soil sample from the clay strata underlying the surface fill material was collected from 0.5m in borehole BH1 to determine whether contamination from the drum storage area had penetrated into the underlying clay.

Groundwater was not encountered during drilling and no groundwater had accumulated in the boreholes when they were inspected 11 days later on the 30 March 1993.

Borehole and trial pit logs are presented in Appendix I.

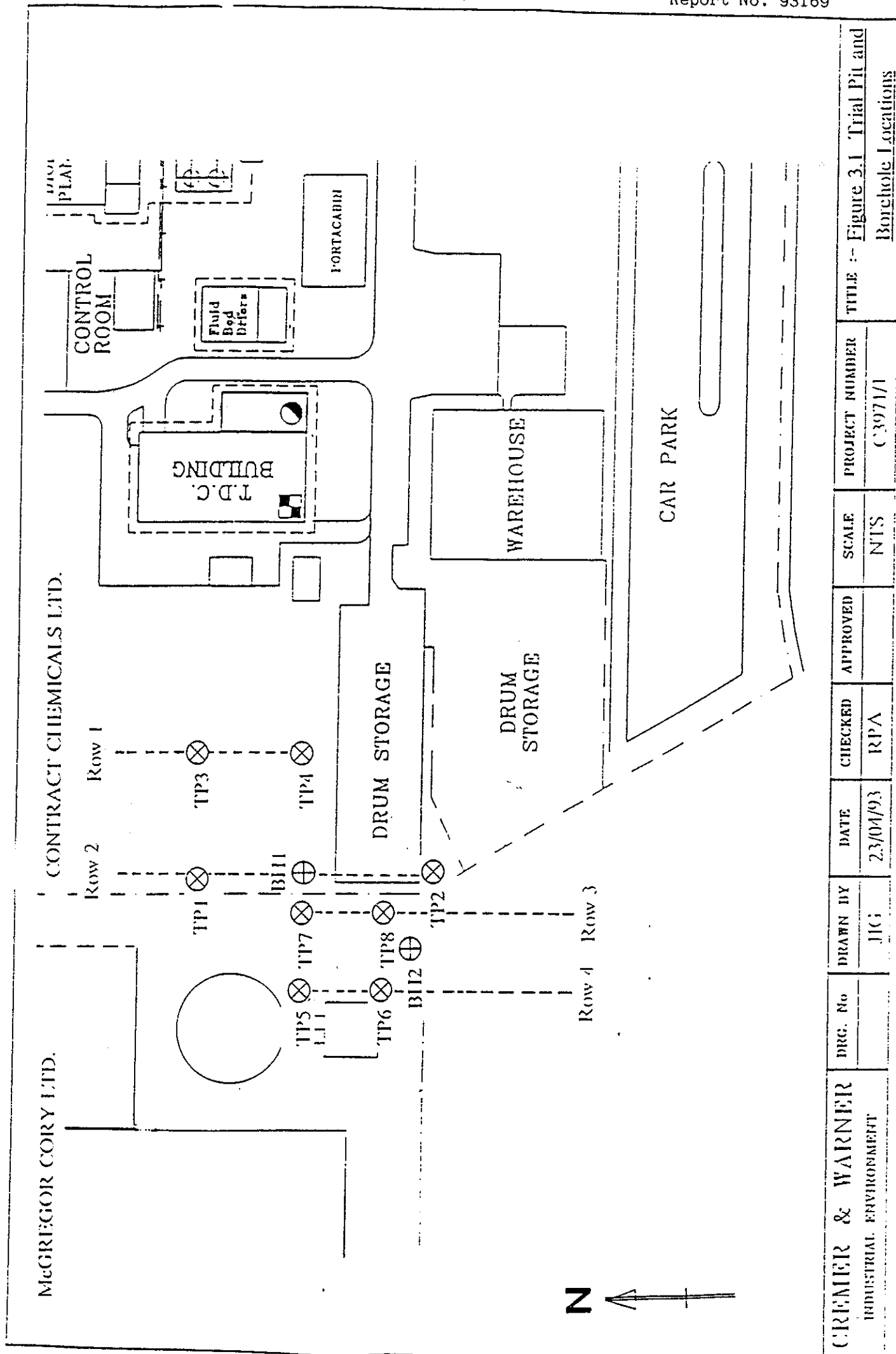
3.2 Analytical Strategy

The analytical technique most applicable to identify and quantify the aromatic and other hydrocarbon contaminants potentially present in the samples was a combination of gas chromatography and mass spectrometry (GC/MS).

The GC/MS technique used two different extractions to identify semi-volatile and volatile compounds respectively. The compounds expected to be identified were semi-volatile in nature and a full GC/MS scan was run for the sample collected on the MC site nearest the perimeter fence, i.e. Row 3 (sample reference TP7,8) where surface discoloration indicated the presence of contaminants. On the basis of this analysis, the ten most abundant contaminants were subsequently targeted for all other samples submitted.

To determine whether contamination by volatile compounds such as benzene, toluene and chloroform had occurred on the MC site, a single GC/MS scan was carried out on sample Row 3 (TP7,8). As a result of compositing samples, the analysis for volatile compounds, which could be lost during compositing, can only be regarded as semi-quantitative, but provides a good indication of whether contamination by volatiles has occurred.

All analytical work was performed by Scientific Analysis Laboratories, Eccles. The certificates of analysis detailing all the results are presented as received in Appendix II.



CREMER & WARNER INDUSTRIAL ENVIRONMENT	DRG. No.	DRAWN BY JIG	DATE 23/04/93	CHECKED RPA	APPROVED	SCALE NTS	PROJECT NUMBER C3971/1		TITLE -- Figure 3.1 Trial Pit and Borehole Locations	

4.0 CONTAMINATION CONDITIONS

4.1 On-site Observations

Surface Run-off

A surface walk-over indicated that overland flow from CC land to MC property occurs principally at two points. The first is located at the south west corner of Area A near to a drainage pipe running from CC to the site boundary, the other further along the perimeter fence opposite the storage tank on MC land.

At this second point of migration it was evident that potentially contaminated surface water from Area B drained along the embankment on the site boundary towards the south west corner of Area A where the water collected. Fine, purple to black silts possessing an acrid, pungent odour had built up in areas of water flow.

Where overland flow appeared to have occurred towards the storage tank, a degree of vegetation stress was observed, resulting in an absence of the grassward, which was present elsewhere in the vicinity.

Other Observations

By the southern corner of Area A near to the perimeter fence, black tar-like material was seeping slowly from the sides of Area A down towards the drainage pipe running from the CC site to the MC boundary.

The original area of hardstanding used for drum storage (Area B) was discoloured at a variety of locations. Occasional pools of potentially contaminated surface water were observed.

The upper 0.5m of the site investigation area comprised fill material consisting of bricks, building rubble, rags and glass in a clayey sand matrix. This was succeeded by firm clay overlying clayey mudstone. The mudstone base rock was encountered at a depth of 2m.

4.2 Ground Conditions

The results of the laboratory analysis can be summarised as follows:

The most prevalent semi-volatile organic contaminants identified by GC/MS were:

C₄ Benzene compounds (4 unidentified alkyl substituted benzene compounds)

Naphthalene

Benzophenone

Benzene diamine methyl ethyl phenyl

Benzene 1,1,1 methlidyne tris

A diamine with molecular weight of 268, corresponding to the molecular weight of "Permanax - 6PPD"

Unknown brominate, molecular weight 294

Unknown compound, molecular weight 218

Unknown compound, molecular weight 86

In addition, small quantities of the volatile compounds toluene and chloroform were detected.

The concentrations of semi-volatile compounds present in the samples collected are summarised below:

Chemical Species	Sample				
	Row 1 (TP3,4) ⁽²⁾	Row 2 (TP1,2) ⁽²⁾	Row 3 (TP7,8) ⁽³⁾	Row 4 (TP5,6) ⁽³⁾	BH1 ⁽²⁾
C ₄ Benzenes	16.70	ND ⁽¹⁾	4.19	ND	ND
Napthalene	1.60	ND	0.92	ND	ND
Unknown (M.Wt 218)	ND	ND	0.33	ND	ND
Benzophenone	1.70	0.42	1.40	0.06	27.5
Unknown Brominate (M.Wt 294)	3.00	1.90	3.50	0.32	ND
Unknown (M.Wt 86)	ND	ND	0.60	ND	ND
Benzene diamine methyl ethyl phenyl	ND	ND	1.00	ND	ND
Benzene 1, 1, 1 methylidyne trio	ND	ND	0.35	ND	ND
Unknown diamine (M.Wt 268)	6.00	ND	3.50	ND	0.02
pH	9.4	8.7	8.9	8.5	8.7

Notes: All values expressed in mg/Kg dry soil.

- (1) ND - Not detected.
- (2) Collected from CC land.
- (3) Collected from MC land.

4.3.1 UK Guidelines

In the UK, current government guidelines are issued by the Interdepartmental Committee on the Redevelopment of Contaminated Land (ICRCL) in ICRCL guidance note 59/83 entitled "Guidance on the assessment and redevelopment of contaminated land".

The ICRCL guidelines propose various tentative contaminant trigger concentrations which are acceptable for a given proposed land-use. Above this trigger threshold concentration, remedial action may be needed, depending upon circumstances.

4.3.2 US, Dutch and Canadian Guidelines

Where appropriate UK guidelines are absent, reference is made to widely used overseas soil guidelines.

Dutch guidelines have found widespread use in the UK, but have recently been withdrawn in the Netherlands prior to review. They are included in this report for comparative purposes only. They have been based upon classifying contaminant concentrations into 3 classes; A, B and C. Concentrations above class B may require further investigation and above class C will require remedial action. The guidelines as they appeared prior to review are listed in Appendix III. Reference is also made to proposed State of New Jersey residential soil clean-up guidelines.

4.3.2 Comparison of Appropriate Guidelines with Contamination Conditions

Semi-Volatile Compounds

As stated previously, few of the guidelines referred to in Section 4.3.1 relate to compounds identified in this report. Where guidelines do exist they have been quoted in the following table in the context of maximum contaminant concentrations found in CC and MC land respectively.

Component	Maximum Concentration (CC land) mg/kg dry soil	Maximum Concentration (MC land) mg/kg dry soil	Appropriate Standard mg/kg dry soil
Naphthalene	1.60	0.92	0.1 (Dutch A classification) 5 (Dutch B classification) 50 (Dutch C classification) (See Notes 1 & 2)
Total aromatic hydrocarbons	29.00 ⁽³⁾	15.79 ⁽³⁾	7 (Dutch B classification) 70 (Dutch C classification)

Notes

- (1) ICRCL threshold guideline for total polycyclic aromatic hydrocarbons for buildings and hard cover is 1000 mg/kg.
- (2) Proposed soil standard for naphthalene in the State of New Jersey (1992) is 230 mg/kg.
- (3) The contribution of contaminants other than those identified is unknown and therefore concentrations quoted should be taken as minimum expected values.

Volatile Compounds

Guidelines on acceptable concentrations of volatile soil compounds are not available in the UK. The concentrations of the volatile compounds identified benzene, toluene and chloroform, which as stated previously can only be regarded as semi-quantitative, were significantly below standards and guidelines in the US and The Netherlands.

4.4 Interpretation of Results

The results may be interpreted as follows:

- (i) Generally the highest concentrations of contaminants were found in the sample collected from Row 1 (TP3,4) 15m from the boundary fence on CC land.
- (ii) Only low concentration levels of several contaminants were detected in Row 2 near the boundary fence on CC land (TP1,2).
- (iii) Sample BH1 collected from the top of the underlying clay strata contained low concentrations of hydrocarbon contaminants with the exception of benzophenone.
- (iv) Moderate concentrations of aromatic contaminants were found in the sample collected from Row 3 (TP7,8). Row 3 was located on the MC site where surface run-off from the CC site appeared to have collected.
- (v) Row 3 (TP7,8) contained four compounds, two of which were unidentified, which were not detected at any other locations, either on MC land or CC property.
- (vi) Row 4 (TP5,6), located 5m from the boundary fence contained very low concentrations of only 2 contaminants present in Row 3 (TP7,8). Any of the other compounds which were being tested for were below detectable limits.
- (vii) All samples tested were slightly alkaline. The highest levels of pH are at Row 1 (TP3,4) and Row 3 (TP7,8) where the highest levels of organic contamination were detected.

These results indicate that contamination by identified compounds is probably limited on MC land to the vicinity of the boundary between CC and MC property. The identification of the proprietary compound "Permanax 6PPD" on MC land could only have originated from the CC site with migration of this and other compounds occurring overland through surface run-off from the drum storage area.

In conjunction with on-site observations the results from sample BH1 would indicate that the contamination was restricted mainly to the upper 0.5m of soil and that the underlying clay restricted vertical migration of contamination.

5.0 SUMMARY

The following key points and tentative conclusions can be drawn from this preliminary site investigation.

- (i) Soil contaminants identified on CC and MC sites suggests that contamination has migrated from CC property onto land owned by MC.
- (ii) From visual observations, migration appears to have occurred overland at two principal points, with contaminated surface water being channelled along the embankment bordering the MC and CC sites to collect in the south west corner of MC property. Based upon analytical results, contamination would appear to be concentrated in this area as a result and only very low levels of contamination were detected on MC property 5m from the site boundary.
- (iii) For most of the compounds identified, ground contamination standards are unavailable. However, where guidelines are available, for example, for total aromatic compounds, 'moderate' rather than 'heavy' contamination of the samples was identified.
- (iv) The surface ponding observed is a consequence of the impermeability of the underlying clay strata, generally found at a depth of 0.5m.
- (v) It is likely that the clay strata has restricted the vertical migration of contaminants to the upper soil layers.

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Netherlands Test Tables for Soil and Groundwater Contamination, taken from the "Symposium on Redevelopment of Contaminated Land". The Instruction of Water and Environmental Management (1990).

New Jersey Clean-up Standards for Contaminated Sites; Proposed New Rules : NJAC 7:26D, 1992, US.

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APPENDIX I

TRIAL PIT AND BOREHOLE LOGS

METHOD		CONTRACTOR	TRIAL PIT NO.	
Back Hoe Excavator		Maron (JCB) Hire	TP1	
SURFACE OBSERVATION Lightly stained surface		DATE: 19/03/93	GRID REF.	
		SITE: Contract Chemicals Ltd., Knowsley	LOGGED BY (Initials) JIG	
DEPTH (m)	DESCRIPTION OF STRATA		WATER	SAMPLES
	Aggregate hardstanding. Mild odour.		Slow water ingress	
	Fill: Stiff, brown boulder clay.			
0.5	Stiff, deep red clay.			
	Firm, plasticity brown to grey clay.			
1.0	Base of hole.			
1.5				
2.0				
2.5				
3.0				
CREMER & WARNER Safety, Environment, Engineering		CLIENT Contract Chemicals Ltd.		
		PROJECT: Contaminated Land Investigation		JOB NO. C3971/1

METHOD		CONTRACTOR	TRIAL PIT NO.	
Back Hoe Excavator		Maron (JCB) Hire	TP2	
SURFACE OBSERVATION Stained surface. Black tarry material on side of raised hardstanding.		DATE: 19/03/93	GRID REF.	
		SITE: Contract Chemicals Ltd., Knowsley	LOGGED BY (Initials) JIG	
DEPTH (m)	DESCRIPTION OF STRATA		WATER	SAMPLES
	Aggregate with coarse sands; fine to medium gravels. Moderate pungent odour.		Moist soil	
0.5	Electric cable detected very close by. Hole abandoned.			
1.0				
1.5				
2.0				
2.5				
3.0				
CREMER & WARNER Safety, Environment, Engineering		CLIENT Contract Chemicals Ltd.		
		PROJECT: Contaminated Land Investigation		JOB NO. C3971/A

METHOD		CONTRACTOR	TRIAL PIT NO.	
Back Hoe Excavator		Maron (JCB) Hire	TP3	
SURFACE OBSERVATION Black stained surface		DATE: 19/03/93	GRID REF.	
		SITE: Contract Chemicals Ltd., Knowsley	LOGGED BY (Initials) JIG	
DEPTH (m)	DESCRIPTION OF STRATA		WATER	SAMPLES
	Compacted aggregate.		Dry	
	Fill: Firm, clayey sand with ash.			
0.5	Fill: Building rubble, bricks, glass and cloth in clayey sand matrix.			
1.0	Base of hole.			
1.5				
2.0				
2.5				
3.0				
CREMER & WARNER Safety, Environment Engineering		CLIENT Contract Chemicals Ltd.		
		PROJECT: Contaminated Land Investigation		JOB NO. C39711/1

METHOD		CONTRACTOR	TRIAL PIT NO.	
Back Hoe Excavator		Maron (JCB) Hire	TP4	
SURFACE OBSERVATION Visible pools of black, discoloured water		DATE: 19/03/93	GRID REF.	
		SITE: Contract Chemicals Ltd., Knowsley	LOGGED BY (Initials) JIG	
DEPTH (m)	DESCRIPTION OF STRATA		WATER	SAMPLES
	Compacted aggregate with coarse sands.		Moist soil	
	Fill: Sandy grey clay Mild odour.			
0.5	Fill: Building rubble, bricks and cloth in clayey sand matrix.			
	Firm, red to grey marly clay. Moderate pungent odour.			
1.0	Base of hole.			
1.5				
2.0				
2.5				
3.0				
CREMER & WARNER Safety, Environment, Engineering		CLIENT Contract Chemicals Ltd.		
		PROJECT: Contaminated Land Investigation		JOB NO. C3971/1

METHOD		CONTRACTOR	TRIAL PIT NO.	
Back Hoe Excavator		Maron (JCB) Hire	TP5	
SURFACE OBSERVATION Grass cover. No visible surface contamination		DATE: 19/03/93	GRID REF.	
		SITE: McGregor Cory Ltd., Knowsley	LOGGED BY (Initials) JIG	
DEPTH (m)	DESCRIPTION OF STRATA		WATER	SAMPLES
—	Fill: Grey, clayey topsoil.		Dry	
—	Plasticity, red clay.			
0.5				
—	Electric cable running in very close vicinity alongside pump house and storage tank.			
—	Base of hole.			
1.0				
—				
1.5				
—				
2.0				
—				
2.5				
—				
3.0				
CREMER & WARNER		CLIENT		
Safety/Environment/ Engineering		Contract Chemicals Ltd.		
		PROJECT: Contaminated Land Investigation		JOB NO. C3971/1

METHOD		CONTRACTOR	TRIAL PIT NO.	
Back Hoe Excavator		Maron (JCB) Hire	TP6	
SURFACE OBSERVATION Grass cover		DATE: 19/03/93	GRID REF.	
		SITE: McGregor Cory Ltd., Knowsley	LOGGED BY (Initials) JIG	
DEPTH (m)	DESCRIPTION OF STRATA		WATER	SAMPLES
—	Loose, clayey topsoil matrix with fine gravels.		Dry	
—	* Fill: Building rubble, bricks and wood fragments in sand matrix.			
0.5	Very mild organic odour			
—	Brittle, red, sandy clay.			
—	Base of hole.			
1.0				
1.5				
2.0				
2.5				
3.0				
CREMER & WARNER Safety/Environment/ Engineering		CLIENT Contract Chemicals Ltd.		
		PROJECT: Contaminated Land Investigation		JOB NO. C3971/1

METHOD		CONTRACTOR	TRIAL PIT NO.
Back Hoe Excavator		Maron (JCB) Hire	TP7
SURFACE OBSERVATION Grass cover		DATE: 19/03/93	GRID REF.
		SITE: McGregor Cory Ltd., Knowsley	LOGGED BY (Initials) JIG
DEPTH (m)	DESCRIPTION OF STRATA	WATER	SAMPLES
—	Clayey topsoil with rootlets.	Moist soil	
—	Plasticity grey clay with coarse gravels		
0.5	Fill: Building rubble and coarse angular stones in sandy matrix		
—	Hard, brittle red, sandy clayey marl (mudstone).		
1.0	Base of hole.		
1.5			
2.0			
2.5			
3.0			
—			
CREMER & WARNER Safety Environment Engineering		CLIENT Contract Chemicals Ltd.	JOB NO. C3971/1
		PROJECT: Contaminated Land Investigation	

METHOD		CONTRACTOR	TRIAL PIT NO.	
Back Hoe Excavator		Maron (JCB) Hire	TP8	
SURFACE OBSERVATION Large, discoloured, pool of surface water with oily film. Poor vegetation cover		DATE: 19/03/93	GRID REF.	
		SITE: McGregor Cory Ltd., Knowsley	LOGGED BY (Initials) JIG	
DEPTH (m)	DESCRIPTION OF STRATA	WATER	SAMPLES	
—	Loose, clayey topsoil matrix with fine gravels.	Moist soil		
—	Fill: Bricks and building rubble with cloth in clayey matrix.			
0.5	Moderate pungent odour			
—	Brittle, firm, red, sandy clay with occasional black streaking. Mild odour			
1.0	Base of hole.			
—				
—				
—				
—				
1.5				
—				
—				
—				
2.0				
—				
—				
—				
2.5				
—				
—				
—				
3.0				
CREMER & WARNER Safety Environment Engineering		CLIENT Contract Chemicals Ltd.		
		PROJECT: Contaminated Land Investigation		JOB NO. C3971/1

METHOD		CONTRACTOR	TRIAL PIT NO.
Light Percussion Drilling		IDEC Exploration	BH1
SURFACE OBSERVATION		DATE: 19/03/93	GRID REF.
		SITE: Contract Chemicals Ltd., Knowsley	LOGGED BY (Initials) HH
DEPTH (m)	DESCRIPTION OF STRATA	WATER	SAMPLES
	Limestone hardstanding.		
0.5	Firm, red, marly clay with hard, laminated marl bands.		X
1.0			
1.5			
2.0			
2.5	Hard, red, sandy, clayey marl (mudstone).		
3.0			
CREMER & WARNER Safety Environment Engineering		CLIENT Contract Chemicals Ltd.	JOB NO. C3971/1
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METHOD	CONTRACTOR	TRIAL PIT NO.	
Light Percussion Drilling	IDEC Exploration	BH1 (cont'd)	
SURFACE OBSERVATION	DATE: 19/03/93	GRID REF.	
	SITE: Contract Chemicals Ltd., Knowsley	LOGGED BY (Initials) HH	
DEPTH (m)	DESCRIPTION OF STRATA	WATER	SAMPLES
_____ _____ _____ _____ 3.5 _____ _____ _____ _____ 4.0 _____ _____ _____ _____ 4.5 _____ _____ _____ _____ 5.0 _____ _____ _____ _____ 5.5 _____ _____ _____ _____ 6.0	Hard, red, sandy, clayey marl.	Dry	
	Base of hole.		
CREMER & WARNER Safety Environment Engineering		CLIENT Contract Chemicals Ltd. PROJECT: Contaminated Land Investigation	JOB NO. C3971/1

METHOD		CONTRACTOR	TRIAL PIT NO.	
Light Percussion Drilling		IDEC Exploration	BH2	
SURFACE OBSERVATION Light grass cover. Surface water nearby		DATE: 19/03/93	GRID REF.	
		SITE: McGregor Cory Ltd., Knowsley	LOGGED BY (Initials) HH	
DEPTH (m)	DESCRIPTION OF STRATA		WATER	SAMPLES
0.5	Fill: Stiff, brown boulder clay with bricks.			
1.0				
1.5	Compact, brown to yellow, clayey sand.			
2.0	Stiff, red, marly clay with hard marl bands.			
2.5	Hard, red, clayey sandy marl (mudstone).			
3.0				
CREMER & WARNER Safety/Environment/ Engineering		CLIENT Contract Chemicals Ltd		
		PROJECT: Contaminated Land Investigation		JOB NO. C3971/1

METHOD		CONTRACTOR		TRIAL PIT NO.	
Light Percussion Drilling		IDEC Exploration		BH2 (cont'd)	
SURFACE OBSERVATION Light grass cover. Surface water nearby		DATE: 19/03/93		GRID REF.	
		SITE: McGregor Cory Ltd., Knowsley		LOGGED BY (Initials) HH	
DEPTH (m)	DESCRIPTION OF STRATA			WATER	SAMPLES
3.5	Hard, red, clayey, sandy marl.			Dry	
4.0	Base of hole.				
4.5					
5.0					
5.5					
6.0					
CREMER & WARNER Safety, Environment, Engineering		CLIENT Contract Chemicals Ltd.			
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APPENDIX II
ANALYTICAL RESULTS

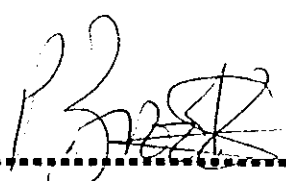
Scientific Analysis Laboratories Ltd

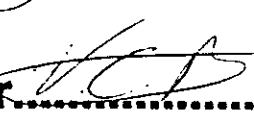
Certificate of Analysis

Job No.: 944E

All analytical results contained within have been obtained in accordance with validated standard operating procedures, which include full QA/QC.

Any deviations from standard operating procedures are noted in the accompanying text.

Analyst..........Date.....5/4/93.....

Quality Manager..........Date.....5/4/93.....

Report on the Analysis of 5 Samples for Semi-Volatile Components

SAL Job No. 944E

Method Summary

The soil samples (approximately 10g) were extracted, using the ultrasonic technique with three separate volumes of 50:50 Dichloromethane:Acetone. Prior to extraction each soil sample was spiked with a deuterated PAH mixture which acts as the internal standard for all quantitation. The solvent layers were decanted off and combined. The extracts were concentrated and combined prior to injection on the GC/MS. Sample 944E001 (your ref. TP7,8) was to be used to identify and quantitate the 10 largest components and these components were then to be targeted and quantitated in the remaining samples.

A method blank is processed in the same way.

A 1ul aliquot of the concentrated extract is injected in the splitless mode onto a 40 m J&W DB-5 fused silica capillary column directly coupled to the ion source of a VG7070HS mass spectrometer operating in the repetitive scanning mode from m/z 500 to m/z 50 at a resolving power of 500 (10% valley definition). Spectra of interest are identified by comparing them with those contained in the NIST mass spectral database. Confirmation is performed by the operator and, where appropriate, comments are made in the sample report.

The GC conditions used for the analysis are as follows:

Injector Temperature:	300°C
Initial Temperature:	60°C, held for 2 minutes
Ramp Rate:	8°C / minute
Final Temperature:	320°C, held for 5 minutes

Sample Results

The reconstructed total ion chromatograms for sample 944E001 is given in figure 1.

Table 1 gives the identification (where possible) and quantity of the 10 most abundant components of the mixture. The quantitation is based on comparison of the area of the unknown with that of the deuterated PAH standard with the assumption that the relative response of the unknown to the standard is unity.

TABLE 1

COMPOUND	ug in sample	ug/kg sample
C ₄ Benzene	4.6	460
C ₄ Benzene	13	1300
C ₄ Benzene	18	1800
C ₄ Benzene	6.3	630
Naphthalene	9.2	920
Unknown (M.Wt. 218)	3.3	330
Benzophenone	14	1400
Unknown brominated (M.Wt 294)	35	3500
Unknown (Base peak m/z 86)	6	600
Benzenediamine methylethyl phenyl	10	1000
Benzene 1,1,1 methylidyne tris	3.5	350
Unknown diamine (M.Wt. 268)	35	3500

Note: Unknown means that a library fit was not available but some of the spectral characteristics are represented in the table and were used to identify these components in the other samples.

Sample 944E002 (Your ref TP1,2)

COMPOUND	ug in sample	ug/kg sample
C ₄ Benzene	n.d.	n.d.
C ₄ Benzene	n.d.	n.d.
C ₄ Benzene	n.d.	n.d.
C ₄ Benzene	n.d.	n.d.
naphthalene	n.d.	n.d.
Unknown (M.WT. 218)	n.d.	n.d.
Benzophenone	4.2	420
Unknown brominated (M.Wt 294)	19	1900
Unknown (Base peak m/z 86)	n.d.	n.d.
Benzenediamine methylethyl phenyl	n.d.	n.d.
Benzene 1,1,1 methylidyne tris	n.d.	n.d.
Unknown diamine (M.Wt. 268)	n.d.	n.d.

Sample 944E003 (Your ref TP3,4)

COMPOUND	ug in sample	ug/kg sample
C ₄ Benzene ,	33	3300
C ₄ Benzene	35	3500
C ₄ Benzene	65	6500
C ₄ Benzene	34	3400
Naphthalene	16	1600
Unknown (M.WT. 218)	n.d.	n.d.
Benzophenone	17	1700
Unknown brominated (M.Wt 294)	30	3000
Unknown (Base peak m/z 86)	n.d.	n.d.
Benzenediamine methylethyl phenyl	n.d.	n.d.
Benzene 1,1,1 methylidyne tris	n.d.	n.d.
Unknown diamine (M.Wt. 268)	60	6000

Sample 944E004 (Your ref BH1 (0.5))

COMPOUND	ug in sample	ug/kg sample
C ₄ Benzene	n.d.	n.d.
C ₄ Benzene	n.d.	n.d.
C ₄ Benzene	n.d.	n.d.
C ₄ Benzene	n.d.	n.d.
Naphthalene	n.d.	n.d.
Unknown (M.WT. 218)	n.d.	n.d.
Benzophenone	275	27500
Unknown brominated (M.Wt 294)	n.d.	n.d.
Unknown (Base peak m/z 86)	n.d.	n.d.
Benzenediamine methylethyl phenyl	n.d.	n.d.
Benzene 1,1,1 methylidyne tris	n.d.	n.d.
Unknown diamine (M.Wt. 268)	0.2	20

Sample 944E005 (Your ref TP5,6)

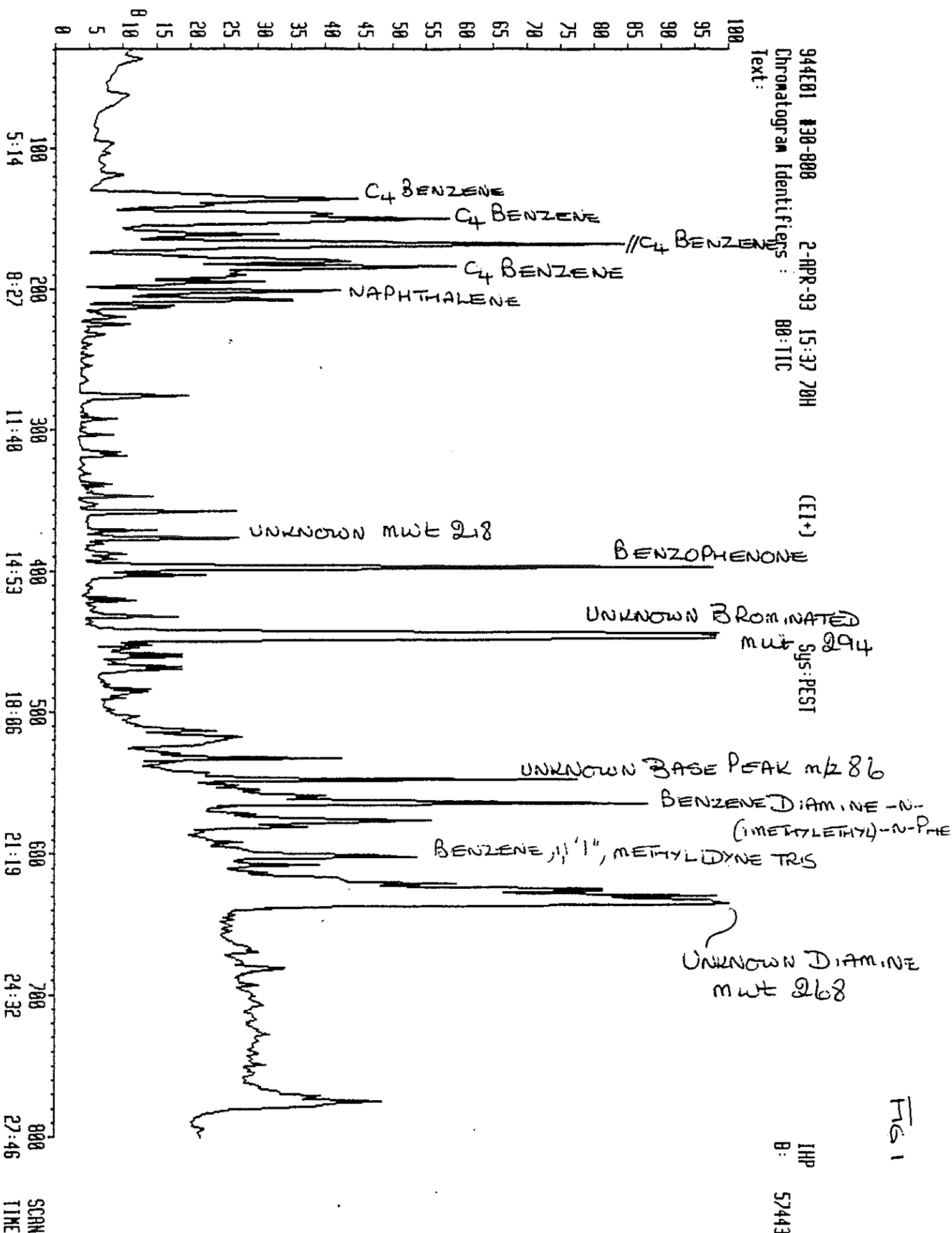
COMPOUND	ug in sample	ug/kg sample
C ₄ Benzene	n.d.	n.d.
C ₄ Benzene	n.d.	n.d.
C ₄ Benzene	n.d.	n.d.
C ₄ Benzene	n.d.	n.d.
Naphthalene	n.d.	n.d.
Unknown (M.WT. 218)	n.d.	n.d.
Benzophenone	0.6	60
Unknown brominated (M.Wt 294)	3.2	320
Unknown (Base peak m/z 86)	n.d.	n.d.
Benzenediamine methylethyl phenyl	n.d.	n.d.
Benzene 1,1,1 methylidyne tris	n.d.	n.d.
Unknown diamine (M.Wt. 268)	n.d.	n.d.

(E1+)

Chromatogram Identifiers

IHP
B: 57443000

Fig 1



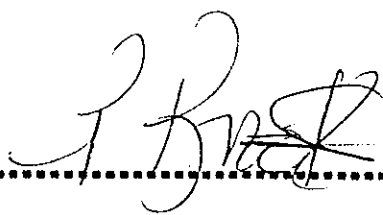
Scientific Analysis Laboratories Ltd

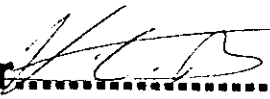
Certificate of Analysis

Job No.: 944E

All analytical results contained within have been obtained in accordance with validated standard operating procedures, which include full QA/QC.

Any deviations from standard operating procedures are noted in the accompanying text.

Analyst..........Date.....5/4/93.....

Quality Manager..........Date.....5/4/93.....

Report on the Analysis of a Sample for Volatiles

SAL Job No. 944E

Method Summary

50g of sample 944E001 (your ref. TP7,8) was transferred to 40 ml septum sealed glass vial. Deuterated Toluene was added to the sample to act as an internal standard for quantitation purposes. A 1 ml aliquot of the headspace from the sample was taken and injected in the splitless mode onto a 30m J&W DB-624 fused capillary column, directly coupled to the ion source of a VG7070HS mass spectrometer. The mass spectrometer is operated in the repetitive scanning mode from m/z 500 to m/z 35 at a resolving power of 500 (10% valley definition). Spectra are recorded as the GC column is heated and those of interest are identified by comparing them with those contained in the NIST mass spectral database. Confirmation is performed by the operator and, where appropriate, comments are made in the sample report.

Quantitation is achieved by comparison of peak areas of components in the sample to the area of the deuterated toluene internal standard. An assumption is made that the total ion response for all analytes is similar.

The GC Conditions used for the volatile analysis are as follows:

Injector Temperature:	140°C
Initial Temperature:	35°C, held for 4 minutes
Ramp Rate:	4°C / minute
Final Temperature:	200°C

The detection limit is estimated to be less than 0.5 ug/kg for components such as benzene.

Sample Results

Table 1 summarises the identities of the major components present in the headspace of sample 944E001 together with the quantitation expressed in ug/kg.

COMPONENT	QUANTITY (ug/kg)
2-Butene	5.4
Di-isopropyl ether	5.9
Chloroform	81
Benzene	1.8
Toluene	160
Ethyl benzene	0.7
m, p Xylene	3.8
Ethyl methyl hexane	2.4
o Xylene	1.1

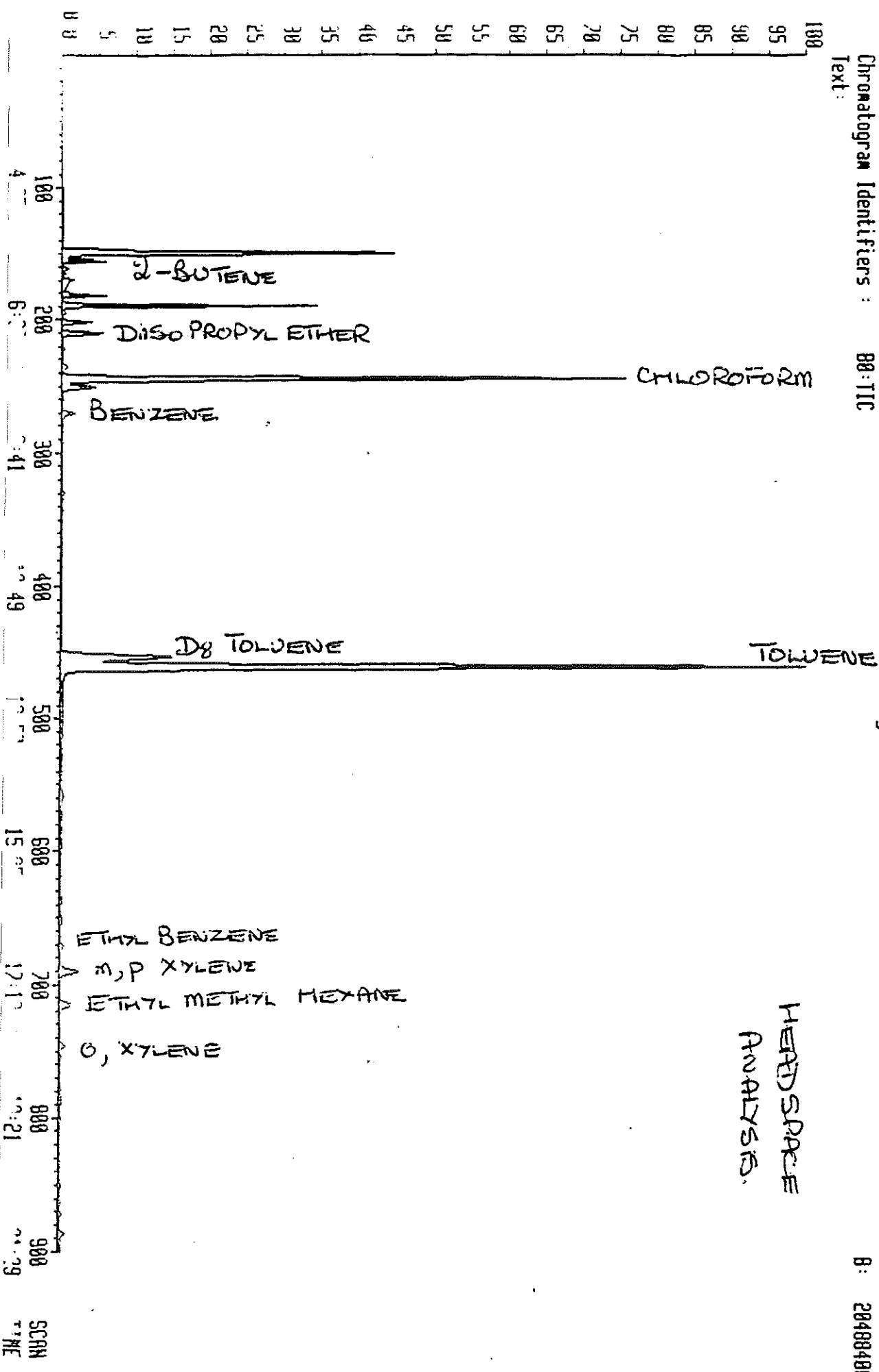
944E015 #1-900 2-APR-93 14:56 70H
Chromatogram Identifiers : 88: TIC
Text:

(EI+)

Sys: VOLATILE

IHP
B: 204884000

HEADSPACE
ANALYSIS.



SCAN
TIME

APPENDIX III

UK AND DUTCH SOIL QUALITY STANDARDS

ICRCL 59/83 (Second Edition) TABLE 4: TENTATIVE "TRIGGER CONCENTRATIONS" FOR CONTAMINANTS ASSOCIATED WITH FORMER COAL CARBONISATION SITES

CONDITIONS

1. This table is invalid if reproduced without the conditions and footnotes.
2. All values are for concentrations determined on "spot" samples based on an adequate site investigation carried out prior to development. They do not apply to analysis of averaged, bulked or composited samples, nor to sites which have already been developed.
3. Many of these values are preliminary and will require regular updating. They should not be applied without reference to the current edition of the report "Problems Arising from the Development of Gas Works and Similar Sites".
4. If all sample values are below the threshold concentrations then the site may be regarded as uncontaminated as far as the hazards from these contaminants are concerned, and development may proceed. Above these concentrations, remedial action may be needed, especially if the contamination is still continuing. Above the action concentrations, remedial action will be required or the form of development changed.

Contaminants	Proposed Uses	Trigger Concentrations	(ug/kg air-dried soil)
		Threshold	Action
Polyaromatic hydrocarbons(1,2)	Domestic gardens, allotments, play areas.	50	500
	Landscaped areas, buildings, hard cover.	1000	10000
Phenols	Domestic gardens, allotments.	5	200
	Landscaped areas, buildings, hard cover.	5	1000
Free cyanide	Domestic gardens, allotments landscaped areas.	25	500
	Buildings, hard cover.	100	500
Complex cyanides	Domestic gardens, allotments.	250	1000
	Landscaped areas.	250	5000
	Buildings, hard cover.	250	NL
Thiocyanate(2)	All proposed uses.	50	NL
Sulphate	Domestic gardens, allotments, landscaped areas.	2000	10000
	Buildings(3).	2000(3)	50000(3)
	Hard cover.	2000	NL
Sulphide	All proposed uses.	250	1000
Sulphur	All proposed uses.	5000	20000
Acidity (pH less than)	Domestic gardens, allotments, landscaped areas.	pH5	pH3
	Buildings, hard cover.	NL	NL

NOTES

- NL: No limit set as the contaminant does not pose a particular hazard for this use.
- (1): Used here as a marker for coal tar, for analytical reasons. See "Problems Arising from the Redevelopment of Gasworks and Similar Sites" Annex A1.
- (2): See "Problems Arising from the Redevelopment of Gasworks and Similar Sites" for details of analytical methods.
- (3): See also BRE Digest 250: Concrete in sulphate-bearing soils and groundwater.

ICRCL 59/83 (Second Edition): TABLE 3 TENTATIVE "TRIGGER CONCENTRATIONS" FOR SELECTED INORGANIC CONTAMINANTS

CONDITIONS

1. This table is invalid if reproduced without the conditions and footnotes.
2. All values are for concentrations determined on "spot" samples based on an adequate site investigation carried out prior to development. They do not apply to analysis of averaged, bulked or composited samples, nor to sites which have already been developed. All proposed values are tentative.
3. The lower values in Group A are similar to the limits for metal content of sewage sludge applied to agricultural land. 2(b) The values in Group B are those above which phytotoxicity is possible.
4. If all sample values are below the threshold concentrations then the site may be regarded as uncontaminated as far as the hazards from these contaminants are concerned and development may proceed. Above these concentrations, remedial action may be needed, especially if the contamination is still continuing. Above the action concentration, remedial action will be required or the form of development changed.

Contaminants	Planned Uses	Trigger Concentrations (mg/kg air dried soil)	
		Threshold	Action
<u>Group A: Contaminants which may pose hazards to health</u>			
Arsenic	Domestic gardens, allotments	10	*
	Parks, playing fields, open space	40	*
Cadmium	Domestic gardens, allotments	3	*
	Parks, playing fields, open space	15	*
Chromium (hexavalent) (1)	Domestic Gardens, allotments	25	*
	Parks, playing fields, open space		
Chromium (total)	Domestic gardens, allotments	600	*
	Parks, playing fields, open space	1,000	*
Lead	Domestic gardens, allotments	500	*
	Parks, playing fields, open space	2,000	*
Mercury	Domestic gardens, allotments	1	*
	Parks, playing fields, open space	20	*
Selenium	Domestic gardens, allotments	3	*
	Parks, playing fields, open space	6	*
<u>Group B: Contaminants which are phytotoxic but not normally hazards to health</u>			
Boron (water-soluble) (3)	Any uses where plants are to be grown	(2, 6) 3	*
Copper (4, 5)	Any uses where plants are to be grown	(2, 6) 130	*
Nickel (4, 5)	Any uses where plants are to be grown	(2, 6) 70	*
Zinc (4, 5)	Any uses where plants are to be grown	(2, 6) 300	*

NOTES:

- * Action concentrations will be specified in the next edition of ICRCL 59/83.
- 1. Soluble hexavalent chromium extracted by 0.1M HCl at 37°C; solution adjusted to pH 1.0 if alkaline substances present.
- 2. The soil pH value is assumed to be about 6.5 and should be maintained at this value. If the pH falls, the toxic effects and the uptake of these elements will be increased.
- 3. Determined by standard ADAS method (soluble in hot water).
- 4. Total concentration (extractable by HNO₃/HClO₄).
- 5. The phytotoxic effects of copper, nickel and zinc may be additive. The trigger values given here are those applicable to the 'worst-case': phytotoxic effects may occur at these concentrations in acid, sandy soils. In neutral or alkaline soils phytotoxic effects are unlikely at these concentrations.
- 6. Grass is more resistant to phytotoxic effects than are most other plants and its growth may not be adversely affected at these concentrations.

TABLE 2
NETHERLANDS
TEST TABLE FOR SOIL AND GROUNDWATER CONTAMINATION

The treatment of polluted soil depends on the nature of the concentrations of polluted substances present in it. In connection with this, a test framework is used in the Netherlands, built up of three values which must be distinguished. These values - consisting of different, ascending levels of concentration A, B and C - are differentiated according to the nature of the pollution:

- level A acts as a reference value. This level may be regarded as an indicative level above which there is demonstrable pollution and below which there is no demonstrable pollution;
- level B is an assessment value. Pollutants above the B level should be investigated more thoroughly. The question asked is: To what extent are the nature, location and concentration of the pollutant(s) of such a nature that it is possible to speak of a risk of exposure to man or the environment;
- level C is to be regarded as the assessment value above which the pollutant(s) should generally be treated.

Present in:	Soil (mg/kg dry matter)			Groundwater (µg/l)		
Component/concentration	A	B	C	A	B	C
i) Metals						
Cr	100	250	800	20	50	200
Co	20	50	300	20	50	200
Ni	50	100	500	20	50	200
Cu	50	100	500	20	50	200
Zn	200	500	3000	50	200	800
As	20	30	50	10	30	100
Mo	10	40	200	5	20	100
Cd	1	5	20	1	2.5	10
Sn	20	50	300	10	30	150
Ba	200	400	2000	50	100	500
Hg	0.5	2	10	0.2	0.5	2
Pb	50	150	600	20	50	200
ii) Inorganic pollutants						
NH ₄ (as N)	-	-	-	200	1000	3000
F (total)	200	400	2000	300	1200	4000
CN (total-free)	1	10	100	5	30	100
CN (total-combined)	5	50	500	10	50	200
S (total)	2	20	200	10	100	300
Br (total)	20	50	300	100	500	2000
PO ₄ (as P)	-	-	-	50	200	700
iii) Aromatic Compounds						
benzene	0.01	0.5	5	0.2	1	5
ethylbenzene	0.05	5	50	0.5	20	60
toluene	0.05	3	30	0.5	15	50
xylenes	0.05	5	50	0.5	20	60
phenols	0.02	1	10	0.5	15	50
aromatics (total)	0.1	7	70	1	30	100

TABLE 2 Continued.

Present in:		Soil (mg/kg dry matter)			Groundwater ($\mu\text{g/l}$)		
Component/concentration		A	B	C	A	B	C
iv) Polycyclic hydrocarbons							
naphthalene		0.1	5	50	0.2	7	30
anthracene		0.1	10	100	0.1	2	10
fenanthrene		0.1	10	100	0.1	2	10
fluoranthene		0.1	10	100	0.02	1	5
pyrene		0.1	10	100	0.02	1	5
1,2 benzopyrene		0.05	1	10	0.01	0.2	1
total polycyclic hydrocarbons		1	20	200	0.2	10	40
v) Chlorinated hydrocarbons							
aliphatic HC	(indiv)	0.1	5	50	1	10	50
aliphatic HC	(total)	0.1	7	70	1	15	70
chlorobenzenes	(indiv)	0.05	1	10	0.02	0.5	2
chlorobenzenes	(total)	0.05	2	20	0.02	1	5
chlorophenols	(indiv)	0.01	0.5	5	0.01	0.3	1.5
chlorophenols	(total)	0.01	1	10	0.01	0.5	2
chlorinated polycyclic HC	(total)	0.05	1	10	0.01	0.2	1
PCB's	(total)	0.05	1	10	0.01	0.2	1
EOCI	(total)	0.1	8	80	1	15	70
vi) Pesticides							
chlorinated organics	(indiv)	0.1	0.5	5	0.05	0.2	1
chlorinated organics	(indiv)	0.1	1	10	0.01	0.5	2
pesticides	(total)	0.1	2	20	0.01	1	5
vii) Other pollutants							
tetrahydrophurane		0.1	4	40	0.5	20	60
pyridine		0.1	2	20	0.5	10	30
tetrahydrothiolene		0.1	5	50	0.5	20	60
cyclohexanes		0.1	6	60	0.5	15	50
styrene		0.1	5	50	0.5	20	60
gasoline		20	100	800	10	40	150
mineral oil		100	1000	5000	20	200	600

