UNDP I GEF
DANUBE
REGIONAL
PROJECT

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TECHNICAL ASSISTANCE FOR IRON GATE SEDIMENTS EVALUATION

Report on Support Activities for the DRP Component on Iron Gates Sediments Evaluation, provided by VITUKI

WORKING FOR THE DANUBE AND ITS PEOPLE

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PROJECT

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ABBREVIATIONS

DRP	Danube Regional Project
VITUKI Kht.	VITUKI Environmental Protection and Water Management Research Institute

EXECUTIVE SUMMARY

DRP's Component 4.2 has the objective to assess the sediment quality in the Iron Gate Reservoir and to prepare initial recommendations for future protection of the Danube River and Black Sea. The project is an assessment of data and information on the Iron Gate sediments and is a step in identifying gaps in the available information.

This assignment (Technical assistance for Iron Gate sediments evaluation) aimed at assisting the Romanian and Serbian National Teams by providing a sampling ship and collection and analysis of samples for direct comparison with the National Teams. The sampling survey was carried out in September 2006 by the ship ARGUS. Grab samples and core samples were taken at the preselected 10 sections in the Iron Gate reservoir region in the Danube reach 928-1107 km.

The determinands total phosphorus, organic nitrogen, heavy metals (mercury, cadmium, lead, nickel, chromium, arsenic, copper, zinc), exctractable petroleum hydrocarbons, organochlorine pesticides (DDT, lindane, aldrin, endrin, dieldrin), nonylphenol, octylphenol, pentachlorphenol, di(2-ethylhexyl)phthalate, PAHs, PCBs and particle size distribution were analyzed by widely used methods in the laboratory of VITUKI Kht.

The analytical results indicate the spatial concentration distribution of different contaminants in the bottom sediment of the Iron Gate reservoir.

The analytical results of the measurements in the VITUKI laboratory can be used for comparative analysis together with the results of the Romanian and Serbian teams for the same samples.

The analytical results contribute to the assessment of sediment contamination in the Iron Gate reservoir.

1. PROJECT OBJECTIVES

The overall objective of the DRP's Component 4.2 is to assess the sediment quality in the Iron Gate Reservoir and to prepare initial recommendations for future protection of the Danube River and Black Sea. The specific objectives include:

1. Collecting and reviewing the existing data and information on present situation (especially heavy metals, nutrients, silicates and other dangerous substances);
2. Assessing the main types and quantities of dangerous substances;
3. Assessing the potential environmental impacts on the Danube and the Black Sea;
4. Forecasting development for a period of 20 years;
5. Discussing possible precautionary and rehabilitation measures for the Danube and the Black Sea;
6. Preparing recommendations for dealing with this problem in the forthcoming decade (measures to be included in the Joint Action Programme of the ICPDR);
7. Undertaking sampling and analysis as agreed by the overall project team
8. Proposing further monitoring programmes.

This project is an assessment of data and information on the Iron Gate sediments and is a step in identifying any gaps in the available information leading to the need for future investment (e.g. international donors) programmes for remediation.

The objectives of this assignment (Provision of Support Activities) is to assist the National Teams (under the direction of the Project Co-ordinator) by:

- Providing a sampling ship;
- Collection and analysis of samples for direct comparison with the National Teams.

2. APPROACH OF WORK IN LINE WITH THE REQUIRED SERVICES

To achieve the objectives of provision of support activities the following tasks were undertaken by the Contractor:

2.1. Provision of a vessel for sampling mission

The International Laboratory was required to obtain the services of an appropriate vessel to enable samples to be collected from the Iron Gate Reservoir.

2.2. Collection of samples

The International Laboratory was required to collect samples (as agreed by the project team) for subsequent analysis.

2.3. Analysis of samples

The International Laboratory was required to analyse the samples for an agreed list of determinands.

3. RESULTS AND CONCLUSIONS

3.1. Provision of a vessel for sampling mission

The ship "Argus" (Serbia) was selected for sampling in the Iron Gate region. The Serbian Ministry of Science and Environmental Protection agreed to rent the ship Argus for the project in the period 10-15 September 2006.

3.2. Collection of samples

A plan was prepared and discussed for sediment sampling sites and sampling schedule.

Table 1 Proposed sediment sampling sites:

No.	Name of sampling site	km	Grab sample+	Core sample++
1	Upstream of Velika Morava	1107	+	
2	Downstream of Velika Morava	1097	+	
3	Ram/Stara Palanka	1077	+	+
4	Veliko Gradiste / Belobresca	1061	+	
5	Golubac / Coronini	1043	+	
6	Dobra / Lubcova	1022	+	
7	Donji Milanovac	990	+	+
8	Dubova	971	+	
9	Orsova	955	+	+
10	Mala Vrbica / Simian	927	+	+

+ upper 10 cm layer of sediment

++vertical profile (10 cm deep layers, max. 1 m deep profile)

Table 2 Schedule of sampling:

Day 1	Departure: Belgrade
	Arrival: Veliko Gradiste
	Sampling at sites No. 1-4
Day 2	Departure: Veliko Gradiste
	Arrival: Donji Milanovac
	Sampling at sites No. 5-7
Day 3	Departure: Donji Milanovac
	Arrival: Mala Vrbica
	Sampling at sites No. 8-10
Day 4	Departure: Mala Vrbica
	Arrival: Belgrade

The actual sampling sites with GPS co-ordinates and sampling dates are listed in Annex Table 1.

3.3. Analysis of samples

Analysis of grab samples from sampling sites No 1 L and R, 2 L and R, 3 L and R, 4 L and R, 5 L and R, 6 L and R, 7 L and R, 8 R, 9 L and R, 10 L and R, Core 1077 R, Core 991 R, Core 956 L were carried out in VITUKI laboratory.

The measured determinands in sediment were: total phosphorus, organic nitrogen, heavy metals (mercury, cadmium, lead, nickel, chromium, arsenic, copper, zinc), exctractable petroleum hydrocarbons, organochlorine pesticides (DDT, lindane, aldrin, endrin, dieldrin), nonylphenol, octylphenol, pentachlorphenol, di(2-ethylhexyl)phthalate, PAHs, PCBs and particle size distribution.

3.4. Applied analytical methods for the analysis of sediment samples in VITUKI

The analytical methods of the determinands applied in VITUKI were as follows:

Heavy metals, trace elements (mercury, cadmium, lead, nickel, chromium, arsenic, copper, zinc)

Sample preparation: microwave digestion of freeze dried sample with nitric acid and hydrogen peroxide.

Analytical method: AAS flame atomization (in case of mercury cold vapour technique, in case of arsenic hydride technique)

Total phosphorus

Sample preparation: digestion of freeze dried sample with sulphuric acid and later with hydrogen peroxide.

Analytical method: the ortho-phosphate reacts with molybdenate. It develops blue colour in the presence of antimon(III) ions, after reduction by ascorbic acid. Measurement at 820 nm.

Organic nitrogen + ammonium-nitrogen

Sample preparation: digestion of freeze dried sample with sulphuric acid and later with hydrogen peroxide.

Analytical method: after the digestion the resultant ammonium reacts with salicilate and hypochlorite ion in the presence of nitroprusside-sodium. Colorimetric measurement at 655 nm.

Extractable petroleum hydrocarbons (GC/FID method)

Sample preparation: extraction of wet sediment with acetone plus hexane solution of squalane. The evaporated residue is dissolved in hexane and cleaned on SPE Si-cartridge. 1-chlor-nonane is added to the sample.

Chromatographic conditions:

Carrier gas: H_2 30 ml/min (0.9 kPa)

Split: 1:60

Column: DB-5, 20 m x 0.25 mm, HP-5 5 % phenyl-methyl-silicone polymer

Di(2-ethyl-hexyl)phthalate

Sample preparation: extraction of wet sediment with acetone plus hexane solution of dipentyl-phtalate. Second extraction with hexane. The hexane solution is cleaned on SPE Si-cartridge. Eluation with dichloro-methane.

GC conditions:

Carrier gas: H_2 30 ml/min (0.9 kPa)

Split: 1:60

Column: DB-5, 20 m x 0.25 mm, HP-5 5 % phenyl-methyl-silicone polymer

PAHs

Sample preparation: d10-fluoranthene and d12-chrisene (dissolved in methanol) is added to the sample. The sample is freeze dried and extracted with dichloro-methane in ultrasonic bath.. The extractum is centrifugated, dried on sodium-sulphate, evaporated by nitrogen , cleaned on SPE Si-cartridge. Eluation with dichloro-methane, ISTD is added..

GC conditions:

Column: DB-5, 30 m, 0.25 mm, 0.25 µm

Carrier gas: He

MS:

Ionisation: El+/SIR, 70 eV, 200µA

Organochlorine pesticides (DDT, lindane, aldrin, endrin dieldrin)

Sample preparation: The sample is freeze dried and extracted with dichloro-methane in ultrasonic bath.. The extractum is cleaned on SPE Si-cartridge. Eluation with dichloro-methane.

GC conditions:

Column: DB-5ms, 30 m, 0.25 mm, 0.25 µm

Carrier gas: He

MS:

Ionisation: El+/SIR, 70 eV, 200µA

R=4000

PCBs

Sample preparation: The sample is freeze dried and extracted with dichloro-methane in ultrasonic bath. The extractum is cleaned on SPE Si-cartridge. Eluation with dichloro-methane.

GC conditions:

Column: DB-5ms, 30 m, 0.25 mm, 0.25 µm

Carrier gas: He

MS:

Ionisation: El+/SIR, 70 eV, 200µA

R=4000

Nonylphenol, octylphenol, pentachlorphenol

Sample preparation: The sample is freeze dried and extracted with dichloro-methane in ultrasonic bath.. The extractum is cleaned on SPE SiOH-cartridge. Eluation with dichloro-methane. Eluate is dried with nitrogen then derivatization: addition of 2,6-diterciel-butylphenol, acetic acid anhydride, triethylamin. 1 hour long reaction at 60 oC. Addition of distilled water, sodium chloride to the cooled sample, extraction with hexane. Analysis with GC-MSD.

Particle size distribution

Granulometric measurement

3.5. Results of measurements

The analytical results (concentrations in dry sediment) are indicated in Annex Table 2.

Figure 1-3. shows selected determinand concentrations in core sample profiles.

Figure 4. shows the particle size distribution results of grab samples.

3.6. Conclusions

> The sediment sampling survey was carried out according to the proposed plan: grab samples and core samples were taken at the preselected sites in the Iron Gate reservoir region.

> The applied analytical methods are widely used procedures.

> The analytical results indicate the spatial concentration distribution of different contaminants in the bottom sediment of the Iron Gate reservoir.

> The analytical results of the measurements in the VITUKI laboratory can be used for comparative analysis together with the results of the Romanian and Serbian teams for the same samples.

> The analytical results contribute to the assessment of sediment contamination in the Iron Gate reservoir.

ANNEXES

ANNEX TABLES AND FIGURES

TABLE 1 ACTUAL SAMPLING SITES AND SAMPLING DATES

Iron Gates sample number	Sample type	Km index	Location	Location in Profile	GPS Coordinates						Sampling Date [MM/DD/YYYY]	S. Time [HH:MM]
					Latitude			Longitude				
					°	`	``	°	`	``		
1	grab	1107	Upstream Velika Morava	L	44	43	33,8	21	00	09.9	2006.09.11	13:30
1	grab	1107	Upstream Velika Morava	R	44	42	58,1	21	00	25,8	2006.09.11	12:50
2	grab	1097	Downstream Velika Morava	L	44	44	16,4	21	07	37,0	2006.09.11	14:45
2	grab	1097	Downstream Velika Morava	R	44	43	44,8	21	07	51,8	2006.09.11	14:57
-	**core**	**1077**	**Stara Palanka - Ram**	**R**	**44**	**48**	**33,0**	**21**	**19**	**43,2**	**2006.09.11**	**17:00**
	0-10 cm											
-	10-20 cm											
-	20-30 cm											
-	30-40 cm											
-	40-50 cm											
-	50-60 cm											
-	60-70 cm											
-	70-77 cm											
3	grab	1072	Bazias	L	44	48	12,9	21	23	31,0	2006.09.11	19:10
3	grab	1072	Bazias	R	44	48	17,3	21	22	48,4	2006.09.11	19:30
4	grab	1061	Veliko Gradiste / Belobresca	L	44	46	33,2	21	29	44,6	2006.09.12	10:00
4	grab	1061	Veliko Gradiste / Belobresca	R	44	46	05.3	21	29	36,3	2006.09.12	10:20
5	grab	1040	Golubac / Koronin	L	44	40	06.7	21	41	20,0	2006.09.12	12:15
5	grab	1040	Golubac / Koronin	R	44	39	40,8	21	41	2,6	2006.09.12	12:00
6	grab	1022	Dobra Lubcova	L	44	38	59,9	21	53	51,3	2006.09.12	14:10
6	grab	1022	Dobra Lubcova	R	44	38	38,7	21	52	56,4	2006.09.12	14:00
7	grab	991	Donji Milanovac	L	44	28	45,4	22	08	35,8	2006.09.13	10:30
7	grab	991	Donji Milanovac	R	44	27	56,3	22	08	15,1	2006.09.13	9:30
-	**core**	**991**	**Donji Milanovac**	**L**	**44**	**28**	**45,4**	**22**	**08**	**35,8**	**2006.09.13**	**12:00**
	0-10 cm											
-	10-20 cm											

Iron Gates sample number	Sample type	Km index	Location	Location in Profile	GPS Coordinates						Sampling Date [MM/DD/YYYY]	S. Time [HH:MM]
					Latitude			Longitude				
					°	`	``	°	`	``		
-	20-30 cm											
-	30-40 cm											
-	40-50 cm											
-	50-60 cm											
-	60-70 cm											
-	70-74 cm											
-	**core**	**991**	**Donji Milanovac**	**R**	**44**	**27**	**56,3**	**22**	**08**	**15,1**	**2006.09.13**	**9:45**
	0-10 cm											
-	10-20 cm											
-	20-30 cm											
-	30-40 cm											
-	40-50 cm											
-	50-60 cm											
-	60-67 cm											
no sediment found on the left side												
8	grab	971	Dubova	R	44	36	23,0	22	16	24,6	2006.09.13	11:40
9	grab	956	Tekija / Orsova	L	44	41	26,0	22	23	43,9	2006.09.13	13:50
9	grab	956	Tekija / Orsova	R	44	41	03.4	22	24	26,1	2006.09.13	13:20
-	**core**	**956**	**Tekija / Orsova**	**L**	**44**	**41**	**26,0**	**22**	**23**	**43,9**	**2006.09.13**	14:00
	0-10 cm											
	10-20 cm											
	20-30 cm											
	30-40 cm											
	40-50 cm											
	50-60 cm											
	60-70 cm											
	70-78 cm											
	core	**956**	**Tekija / Orsova**	**R**	**44**	**41**	**03.8**	**22**	**24**	**26,7**	**2006.09.13**	13:30
	0-10 cm											

Iron Gates sample number	Sample type	Km index	Location	Location in Profile	GPS Coordinates						Sampling Date [MM/DD/YYYY]	S. Time [HH:MM]
					Latitude			Longitude				
					°	`	``	°	`	``		
	10-20 cm											
	20-30 cm											
	30-40 cm											
	40-50 cm											
	50-60 cm											
	60-70 cm											
	70-82 cm											
10	grab	928	Mala Vrbica / Simian	L	44	37	12,1	22	41	06.9	2006.09.13	19:30
10	grab	928	Mala Vrbica / Simian	R	44	36	29,8	22	40	47,6	2006.09.13	19:00
	core	**928**	**Mala Vrbica / Simian**	**R**	**44**	**36**	**29,8**	**22**	**40**	**47,6**	**2006.09.13**	19:00
	0-10 cm											
	10-20 cm											
	20-30 cm											
	30-40 cm											
	40-50 cm											
	50-60 cm											
	60-70 cm											
	70-80 cm											

TABLE 2: ANALYTICAL RESULTS OF THE SEDIMENT INVESTIGATION

Sample code		1-1107-L	1-1107-R
Components	Unit	Concentration	
Fluoranthene	µg/kg	86	87
Benzo(b)fluoranthene	µg/kg	143	136
Benzo(k)fluoranthene	µg/kg	95	88
Benzo(a)pyrene	µg/kg	114	103
Indeno(1,2,3)pyrene	µg/kg	66	61
Benzo(g,h,i)perylene	µg/kg	25	23
PCB-28	µg/kg	<1	<1
PCB-52	µg/kg	<1	<1
PCB-101	µg/kg	<1	<1
PCB-118	µg/kg	<1	<1
PCB-138	µg/kg	<1	<1
PCB-153	µg/kg	<1	<1
PCB-180	µg/kg	<1	<1
Aldrin	µg/kg	<1	<1
Dieldrin	µg/kg	<1	<1
Endrin	µg/kg	<1	<1
DDT	µg/kg	2,1	1,5
Lindane	µg/kg	<1	<1
Octylphenol	µg/kg	<5	<5
Nonyphenol	µg/kg	89	86
Pentachlorphenol	µg/kg	<5	<5
TPH	mg/kg	60	33
DEPH	mg/kg	<0,1	0,2
Mercury	mg/kg	0,25	0,28
Arsenic	mg/kg	13,5	14,2
Cadmium	mg/kg	2,6	3,0
Lead	mg/kg	60	61
Copper	mg/kg	58	47
Zinc	mg/kg	247	288
Chromium	mg/kg	58	66
Nickel	mg/kg	55	84
Total phosphorus	mg/kg	1159	1173
Organic nitrogen	mg/kg	2228	1948

Sample code		2-1097-L	2-1097-R
Components	Unit	Concentration	
Fluoranthene	µg/kg	132	84
Benzo(b)fluoranthene	µg/kg	303	108
Benzo(k)fluoranthene	µg/kg	153	56
Benzo(a)pyrene	µg/kg	204	73
Indeno(1,2,3)pyrene	µg/kg	107	49
Benzo(g,h,i)perylene	µg/kg	51	25
PCB-28	µg/kg	<1	<1
PCB-52	µg/kg	<1	<1
PCB-101	µg/kg	<1	<1
PCB-118	µg/kg	<1	<1
PCB-138	µg/kg	<1	<1
PCB-153	µg/kg	<1	<1
PCB-180	µg/kg	<1	<1
Aldrin	µg/kg	< 1	< 1
Dieldrin	µg/kg	< 1	< 1
Endrin	µg/kg	< 1	< 1
DDT	µg/kg	2	< 1
Lindane	µg/kg	< 1	< 1
Octylphenol	µg/kg	<5	<5
Nonyphenol	µg/kg	64	96
Pentachlorphenol	µg/kg	<5	<5
TPH	mg/kg	16	29
DEPH	mg/kg	0,26	0,53
Mercury	mg/kg	0,27	0,25
Arsenic	mg/kg	16,4	18,8
Cadmium	mg/kg	3,0	3,0
Lead	mg/kg	67	82
Copper	mg/kg	66	49
Zinc	mg/kg	284	282
Chromium	mg/kg	69	100
Nickel	mg/kg	71	143
Total phosphorus	mg/kg	1335	1196
Organic nitrogen	mg/kg	2450	1765

Sample code		3-1072-L	3-1072-R
Components	Unit	Concentration	
Fluoranthene	µg/kg	78	62
Benzo(b)fluoranthene	µg/kg	139	107
Benzo(k)fluoranthene	µg/kg	86	71
Benzo(a)pyrene	µg/kg	105	79
Indeno(1,2,3)pyrene	µg/kg	70	48
Benzo(g,h,i)perylene	µg/kg	25	19
PCB-28	µg/kg	<1	<1
PCB-52	µg/kg	<1	<1
PCB-101	µg/kg	<1	<1
PCB-118	µg/kg	<1	<1
PCB-138	µg/kg	<1	<1
PCB-153	µg/kg	<1	<1
PCB-180	µg/kg	<1	<1
Aldrin	µg/kg	<1	<1
Dieldrin	µg/kg	<1	<1
Endrin	µg/kg	<1	<1
DDT	µg/kg	1,4	1,2
Lindane	µg/kg	<1	<1
Octylphenol	µg/kg	<5	<5
Nonyphenol	µg/kg	87	170
Pentachlorphenol	µg/kg	<5	<5
TPH	mg/kg	24	78
DEPH	mg/kg	0,14	0,57
Mercury	mg/kg	0,27	0,39
Arsenic	mg/kg	14,4	17,2
Cadmium	mg/kg	2,8	3,5
Lead	mg/kg	68	78
Copper	mg/kg	63	57
Zinc	mg/kg	275	320
Chromium	mg/kg	82	79
Nickel	mg/kg	65	96
Total phosphorus	mg/kg	1248	1184
Organic nitrogen	mg/kg	2344	2233

Sample code		4-1061-L	4-1061-R
Components	Unit	Concentration	
Fluoranthene	µg/kg	114	93
Benzo(b)fluoranthene	µg/kg	343	236
Benzo(k)fluoranthene	µg/kg	168	122
Benzo(a)pyrene	µg/kg	242	146
Indeno(1,2,3)pyrene	µg/kg	119	61
Benzo(g,h,i)perylene	µg/kg	57	30
PCB-28	µg/kg	<1	<1
PCB-52	µg/kg	<1	<1
PCB-101	µg/kg	<1	<1
PCB-118	µg/kg	<1	<1
PCB-138	µg/kg	<1	<1
PCB-153	µg/kg	<1	<1
PCB-180	µg/kg	<1	<1
Aldrin	µg/kg	< 1	< 1
Dieldrin	µg/kg	< 1	< 1
Endrin	µg/kg	< 1	< 1
DDT	µg/kg	1,6	1,1
Lindane	µg/kg	< 1	< 1
Octylphenol	µg/kg	<5	<5
Nonyphenol	µg/kg	53	260
Pentachlorphenol	µg/kg	<5	<5
TPH	mg/kg	41	22
DEPH	mg/kg	0,3	0,27
Mercury	mg/kg	0,30	0,36
Arsenic	mg/kg	16,3	22,6
Cadmium	mg/kg	3,0	3,5
Lead	mg/kg	69	93
Copper	mg/kg	64	60
Zinc	mg/kg	286	320
Chromium	mg/kg	78	127
Nickel	mg/kg	68	147
Total phosphorus	mg/kg	1306	1245
Organic nitrogen	mg/kg	1676	1946

Sample code		5-1040-L	5-1040-R
Components	Unit	Concentration	
Fluoranthene	µg/kg	84	54
Benzo(b)fluoranthene	µg/kg	90	89
Benzo(k)fluoranthene	µg/kg	50	47
Benzo(a)pyrene	µg/kg	59	57
Indeno(1,2,3)pyrene	µg/kg	49	102
Benzo(g,h,i)perylene	µg/kg	24	49
PCB-28	µg/kg	<1	<1
PCB-52	µg/kg	<1	<1
PCB-101	µg/kg	<1	<1
PCB-118	µg/kg	<1	<1
PCB-138	µg/kg	<1	<1
PCB-153	µg/kg	<1	<1
PCB-180	µg/kg	<1	<1
Aldrin	µg/kg	< 1	< 1
Dieldrin	µg/kg	< 1	< 1
Endrin	µg/kg	< 1	< 1
DDT	µg/kg	1	1,4
Lindane	µg/kg	< 1	< 1
Octylphenol	µg/kg	<5	<5
Nonyphenol	µg/kg	60	120
Pentachlorphenol	µg/kg	<5	<5
TPH	mg/kg	29	23
DEPH	mg/kg	0,29	0,46
Mercury	mg/kg	0,21	0,31
Arsenic	mg/kg	32,0	20,5
Cadmium	mg/kg	2,9	3,4
Lead	mg/kg	67	80
Copper	mg/kg	377	64
Zinc	mg/kg	279	326
Chromium	mg/kg	60	94
Nickel	mg/kg	59	104
Total phosphorus	mg/kg	1193	1283
Organic nitrogen	mg/kg	1431	2208

Sample code		6-1022-L	6-1022-R
Components	Unit	Concentration	
Fluoranthene	µg/kg	39	60
Benzo(b)fluoranthene	µg/kg	57	98
Benzo(k)fluoranthene	µg/kg	36	62
Benzo(a)pyrene	µg/kg	39	65
Indeno(1,2,3)pyrene	µg/kg	31	46
Benzo(g,h,i)perylene	µg/kg	11	17
PCB-28	µg/kg	<1	<1
PCB-52	µg/kg	<1	<1
PCB-101	µg/kg	<1	<1
PCB-118	µg/kg	<1	<1
PCB-138	µg/kg	<1	<1
PCB-153	µg/kg	<1	<1
PCB-180	µg/kg	<1	<1
Aldrin	µg/kg	<1	<1
Dieldrin	µg/kg	<1	<1
Endrin	µg/kg	<1	<1
DDT	µg/kg	1,6	1,2
Lindane	µg/kg	<1	<1
Octylphenol	µg/kg	<5	<5
Nonyphenol	µg/kg	48	93
Pentachlorphenol	µg/kg	<5	<5
TPH	mg/kg	34	25
DEPH	mg/kg	0,11	0,16
Mercury	mg/kg	0,17	0,28
Arsenic	mg/kg	12,5	16,7
Cadmium	mg/kg	2,3	3,0
Lead	mg/kg	53	68
Copper	mg/kg	70	71
Zinc	mg/kg	211	290
Chromium	mg/kg	60	81
Nickel	mg/kg	55	75
Total phosphorus	mg/kg	1343	1245
Organic nitrogen	mg/kg	2313	2308

Sample code		7-990-L	7-990-R
Components	Unit	Concentration	
Fluoranthene	µg/kg	77	112
Benzo(b)fluoranthene	µg/kg	301	359
Benzo(k)fluoranthene	µg/kg	150	173
Benzo(a)pyrene	µg/kg	198	243
Indeno(1,2,3)pyrene	µg/kg	105	111
Benzo(g,h,i)perylene	µg/kg	50	53
PCB-28	µg/kg	<1	<1
PCB-52	µg/kg	<1	<1
PCB-101	µg/kg	<1	<1
PCB-118	µg/kg	<1	<1
PCB-138	µg/kg	<1	<1
PCB-153	µg/kg	<1	<1
PCB-180	µg/kg	<1	<1
Aldrin	µg/kg	< 1	< 1
Dieldrin	µg/kg	< 1	< 1
Endrin	µg/kg	< 1	< 1
DDT	µg/kg	1,6	1,1
Lindane	µg/kg	< 1	< 1
Octylphenol	µg/kg	<5	<5
Nonyphenol	µg/kg	57	90
Pentachlorphenol	µg/kg	<5	<5
TPH	mg/kg	15	6,4
DEPH	mg/kg	0,28	0,53
Mercury	mg/kg	0,27	0,32
Arsenic	mg/kg	17,7	16,8
Cadmium	mg/kg	2,7	3,1
Lead	mg/kg	69	75
Copper	mg/kg	75	79
Zinc	mg/kg	293	316
Chromium	mg/kg	75	109
Nickel	mg/kg	91	104
Total phosphorus	mg/kg	1315	1219
Organic nitrogen	mg/kg	1972	1873

Sample code		8-971 R
Components	Unit	Concentration
Fluoranthene	µg/kg	72
Benzo(b)fluoranthene	µg/kg	355
Benzo(k)fluoranthene	µg/kg	165
Benzo(a)pyrene	µg/kg	226
Indeno(1,2,3)pyrene	µg/kg	104
Benzo(g,h,i)perylene	µg/kg	47
PCB-28	µg/kg	<1
PCB-52	µg/kg	<1
PCB-101	µg/kg	<1
PCB-118	µg/kg	<1
PCB-138	µg/kg	<1
PCB-153	µg/kg	<1
PCB-180	µg/kg	<1
Aldrin	µg/kg	< 1
Dieldrin	µg/kg	< 1
Endrin	µg/kg	< 1
DDT	µg/kg	1,6
Lindane	µg/kg	< 1
Octylphenol	µg/kg	<5
Nonyphenol	µg/kg	150
Pentachlorphenol	µg/kg	<5
TPH	mg/kg	65
DEPH	mg/kg	0,48
Mercury	mg/kg	0,31
Arsenic	mg/kg	18,4
Cadmium	mg/kg	3,4
Lead	mg/kg	76
Copper	mg/kg	86
Zinc	mg/kg	317
Chromium	mg/kg	77
Nickel	mg/kg	81
Total phosphorus	mg/kg	1384
Organic nitrogen	mg/kg	1863

Sample code		9-956-L	9-956-R
Components	Unit	Concentration	
Fluoranthene	µg/kg	75	92
Benzo(b)fluoranthene	µg/kg	132	177
Benzo(k)fluoranthene	µg/kg	85	115
Benzo(a)pyrene	µg/kg	96	124
Indeno(1,2,3)pyrene	µg/kg	69	96
Benzo(g,h,i)perylene	µg/kg	25	34
PCB-28	µg/kg	<1	<1
PCB-52	µg/kg	<1	<1
PCB-101	µg/kg	<1	<1
PCB-118	µg/kg	<1	<1
PCB-138	µg/kg	<1	<1
PCB-153	µg/kg	<1	<1
PCB-180	µg/kg	<1	<1
Aldrin	µg/kg	<1	<1
Dieldrin	µg/kg	<1	<1
Endrin	µg/kg	<1	<1
DDT	µg/kg	1,4	1,6
Lindane	µg/kg	<1	<1
Octylphenol	µg/kg	<5	<5
Nonyphenol	µg/kg	140	130
Pentachlorphenol	µg/kg	<5	<5
TPH	mg/kg	25	31
DEPH	mg/kg	0,2	<0,1
Mercury	mg/kg	0,27	0,35
Arsenic	mg/kg	17,3	16,2
Cadmium	mg/kg	3,2	3,3
Lead	mg/kg	72	80
Copper	mg/kg	75	86
Zinc	mg/kg	315	334
Chromium	mg/kg	103	87
Nickel	mg/kg	94	98
Total phosphorus	mg/kg	1240	1163
Organic nitrogen	mg/kg	2229	1957

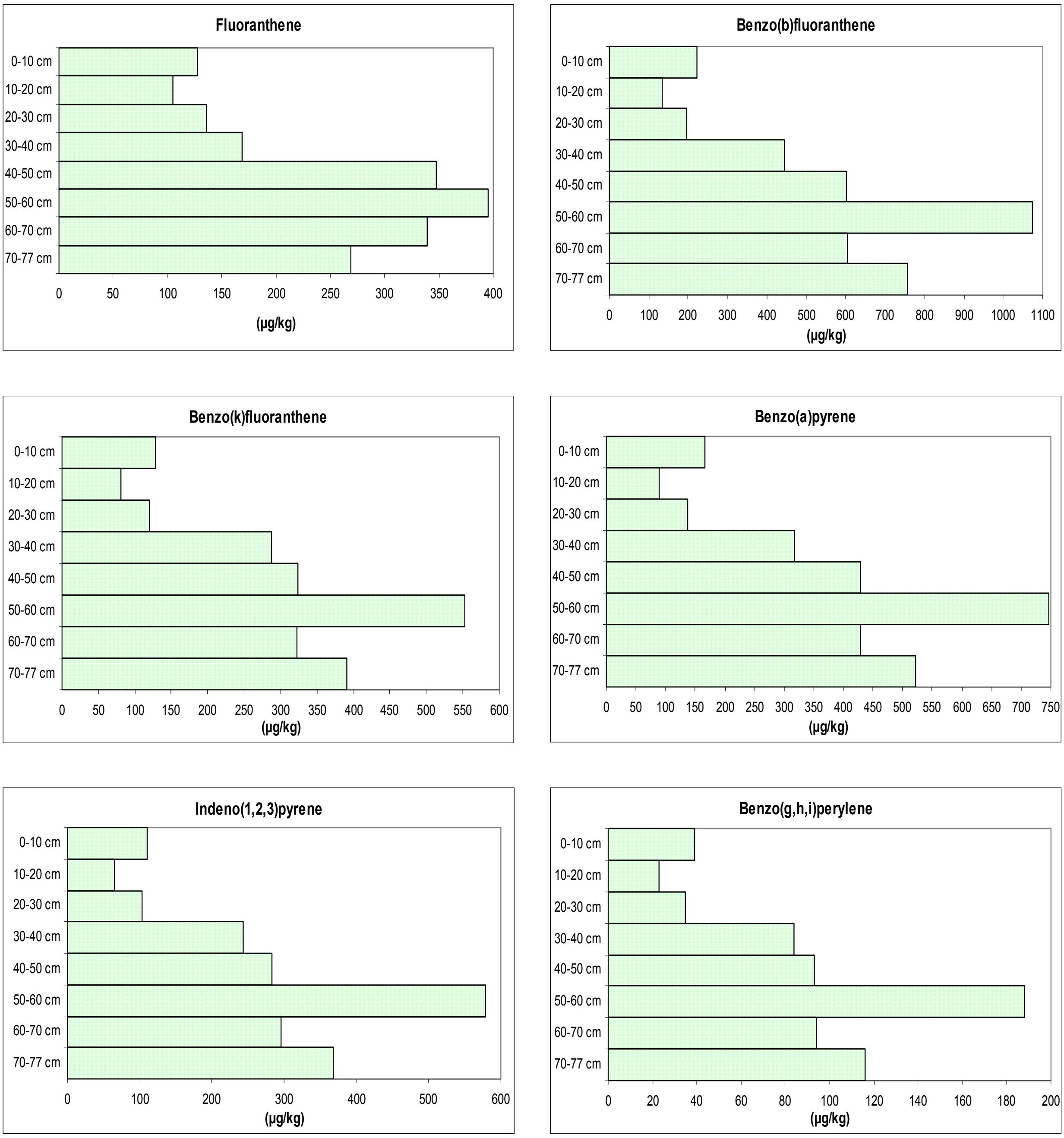
Sample code		10-924-L	10-924-R
Components	Unit	Concentration	
Fluoranthene	µg/kg	35	63
Benzo(b)fluoranthene	µg/kg	52	115
Benzo(k)fluoranthene	µg/kg	29	74
Benzo(a)pyrene	µg/kg	40	95
Indeno(1,2,3)pyrene	µg/kg	29	75
Benzo(g,h,i)perylene	µg/kg	13	29
PCB-28	µg/kg	1,2	<1
PCB-52	µg/kg	<1	<1
PCB-101	µg/kg	<1	<1
PCB-118	µg/kg	<1	<1
PCB-138	µg/kg	<1	<1
PCB-153	µg/kg	<1	<1
PCB-180	µg/kg	<1	<1
Aldrin	µg/kg	<1	<1
Dieldrin	µg/kg	<1	<1
Endrin	µg/kg	<1	<1
DDT	µg/kg	1,2	1,3
Lindane	µg/kg	<1	<1
Octylphenol	µg/kg	<5	<5
Nonyphenol	µg/kg	98	110
Pentachlorphenol	µg/kg	<5	<5
TPH	mg/kg	40	<1
DEPH	mg/kg	0,75	0,1
Mercury	mg/kg	0,22	0,32
Arsenic	mg/kg	10,6	13,4
Cadmium	mg/kg	1,9	3,1
Lead	mg/kg	49	71
Copper	mg/kg	44	86
Zinc	mg/kg	139	294
Chromium	mg/kg	55	85
Nickel	mg/kg	64	80
Total phosphorus	mg/kg	914	1156
Organic nitrogen	mg/kg	1524	2637

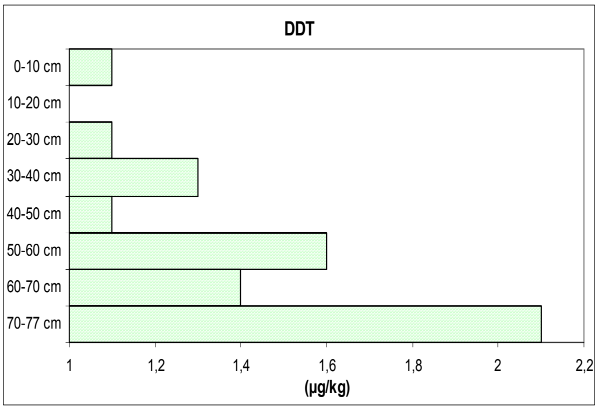
Sample code		1077-R							
	Core	0-10 cm	10-20 cm	20-30 cm	30-40 cm	40-50 cm	50-60 cm	60-70 cm	70-77 cm
Components	Unit	Concentration							
Fluoranthene	µg/kg	127	105	136	169	348	395	339	269
Benzo(b)fluoranthene	µg/kg	221	135	195	444	602	1075	605	756
Benzo(k)fluoranthene	µg/kg	129	81	120	287	324	553	323	390
Benzo(a)pyrene	µg/kg	166	90	137	317	429	746	429	521
Indeno(1,2,3)pyrene	µg/kg	111	65	103	244	283	579	296	368
Benzo(g,h,i)perylene	µg/kg	39	23	35	84	93	188	94	116
PCB-28	µg/kg	<1	<1	<1	<1	1,0	1,6	1,6	2,7
PCB-52	µg/kg	<1	<1	<1	<1	<1	<1	<1	<1
PCB-101	µg/kg	<1	<1	<1	<1	<1	<1	<1	<1
PCB-118	µg/kg	<1	<1	<1	<1	<1	<1	<1	<1
PCB-138	µg/kg	<1	<1	<1	<1	1,3	1,2	1,4	1,7
PCB-153	µg/kg	<1	<1	<1	<1	1,6	1,5	2,0	1,7
PCB-180	µg/kg	<1	<1	<1	<1	1,7	2,0	1,8	1,7
Aldrin	µg/kg	<1	<1	<1	<1	<1	<1	<1	<1
Dieldrin	µg/kg	<1	<1	<1	<1	<1	<1	<1	<1
Endrin	µg/kg	<1	<1	<1	<1	<1	<1	<1	<1
DDT	µg/kg	1,1	<1	1,1	1,3	1,1	1,6	1,4	2,1
Lindane	µg/kg	<1	<1	<1	<1	<1	<1	<1	<1
Octylphenol	µg/kg	<5	<5	<5	<5	<5	19	7,2	8,8
Nonyphenol	µg/kg	300	140	580	1600	4800	11000	5400	3600
Pentachlorphenol	µg/kg	<5	<5	<5	<5	<5	<5	<5	<5
TPH	mg/kg	68	49	108	49	123	220	197	76
DEPH	mg/kg	0,47	0,27	0,45	0,49	0,74	0,84	0,47	0,56
Mercury	mg/kg	0,36	0,35	0,49	0,64	1,05	1,46	1,50	1,36
Arsenic	mg/kg	16,7	18,6	18,7	19,7	27,6	33,3	36,1	58,1
Cadmium	mg/kg	3,1	3,4	4,0	4,6	6,7	9,1	7,1	6,1
Lead	mg/kg	74	77	85	109	151	197	176	168
Copper	mg/kg	54	51	56	65	80	84	72	68
Zinc	mg/kg	292	309	349	446	619	727	682	589
Chromium	mg/kg	89	122	101	105	138	151	174	126
Nickel	mg/kg	105	121	106	104	116	113	133	110
Total phosphorus	mg/kg	1149	1117	1245	1247	1453	1497	1505	1315
Organic nitrogen	mg/kg	2065	1675	1952	1987	2301	2121	2165	2407

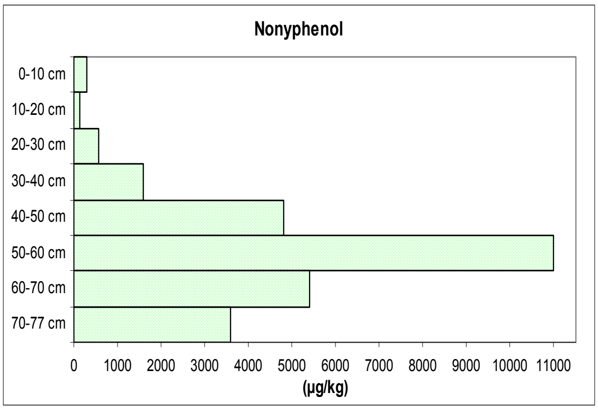
Sample code		991-R					
	Core	0-10 cm	20-30 cm	30-40 cm	40-50 cm	50-60 cm	60-67 cm
Components	Unit	Concentration					
Fluoranthene	µg/kg	44	82	171	157	209	121
Benzo(b)fluoranthene	µg/kg	62	124	226	273	363	170
Benzo(k)fluoranthene	µg/kg	36	63	128	151	187	82
Benzo(a)pyrene	µg/kg	45	89	167	194	232	114
Indeno(1,2,3)pyrene	µg/kg	52	93	212	202	146	115
Benzo(g,h,i)perylene	µg/kg	25	45	96	92	72	56
PCB-28	µg/kg	<1	<1	<1	<1	<1	<1
PCB-52	µg/kg	<1	<1	<1	<1	<1	<1
PCB-101	µg/kg	<1	<1	<1	<1	<1	<1
PCB-118	µg/kg	<1	<1	<1	<1	<1	<1
PCB-138	µg/kg	<1	<1	<1	<1	<1	<1
PCB-153	µg/kg	<1	<1	<1	<1	<1	<1
PCB-180	µg/kg	<1	<1	<1	<1	<1	<1
Aldrin	µg/kg	< 1	< 1	< 1	< 1	< 1	< 1
Dieldrin	µg/kg	< 1	< 1	< 1	< 1	< 1	< 1
Endrin	µg/kg	< 1	< 1	< 1	< 1	< 1	< 1
DDT	µg/kg	< 1	< 1	1,1	1,2	1,9	< 1
Lindane	µg/kg	< 1	< 1	< 1	< 1	< 1	< 1
Octylphenol	µg/kg	<5	<5	<5	<5	<5	<5
Nonyphenol	µg/kg	40	330	450	400	920	1300
Pentachlorphenol	µg/kg	<5	<5	<5	<5	<5	<5
TPH	mg/kg	6,9	38	48	56	46	41
DEPH	mg/kg	<0,1	0,24	0,55	0,37	0,37	0,41
Mercury	mg/kg	0,15	0,33	0,67	0,66	0,77	0,50
Arsenic	mg/kg	12,2	13,4	19,8	20,8	24,2	22,2
Cadmium	mg/kg	2,0	3,0	4,7	4,3	4,5	3,1
Lead	mg/kg	45	70	121	125	128	80
Copper	mg/kg	54	83	137	143	157	123
Zinc	mg/kg	173	258	457	437	484	295
Chromium	mg/kg	110	107	125	106	119	117
Nickel	mg/kg	93	92	90	93	98	105
Total phosphorus	mg/kg	935	1030	1318	1233	1220	1021
Organic nitrogen	mg/kg	1011	1297	1977	1946	2040	983

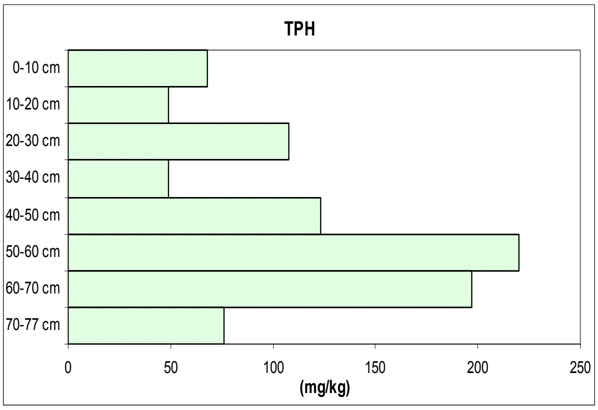
Sample code		956-L							
	Core	0-10 cm	10-20 cm	20-30 cm	30-40 cm	40-50 cm	50-60 cm	60-70 cm	70-78 cm
Components	Unit	Concentration							
Fluoranthene	µg/kg	90	117	141	138	123	121	130	141
Benzo(b)fluoranthene	µg/kg	196	356	149	188	259	190	408	225
Benzo(k)fluoranthene	µg/kg	103	196	85	100	132	103	187	111
Benzo(a)pyrene	µg/kg	131	243	112	133	177	137	280	150
Indeno(1,2,3)pyrene	µg/kg	121	222	110	173	196	126	235	212
Benzo(g,h,i)perylene	µg/kg	41	75	60	84	92	63	115	96
PCB-28	µg/kg	<1	<1	<1	<1	<1	<1	<1	<1
PCB-52	µg/kg	<1	<1	<1	<1	<1	<1	<1	<1
PCB-101	µg/kg	<1	<1	<1	<1	<1	<1	<1	<1
PCB-118	µg/kg	<1	<1	<1	<1	<1	<1	<1	<1
PCB-138	µg/kg	<1	<1	<1	<1	<1	<1	<1	<1
PCB-153	µg/kg	<1	<1	<1	<1	<1	<1	<1	<1
PCB-180	µg/kg	<1	<1	<1	<1	<1	<1	<1	<1
Aldrin	µg/kg	<1	<1	<1	< 1	< 1	< 1	< 1	< 1
Dieldrin	µg/kg	<1	<1	<1	< 1	< 1	< 1	< 1	< 1
Endrin	µg/kg	<1	<1	<1	< 1	< 1	< 1	< 1	< 1
DDT	µg/kg	1,5	1,4	1,3	1,5	1,3	1,3	1,3	1,2
Lindane	µg/kg	<1	<1	<1	< 1	< 1	< 1	< 1	< 1
Octylphenol	µg/kg	<5	<5	<5	<5	<5	<5	<5	<5
Nonyphenol	µg/kg	120	280	260	310	320	240	680	370
Pentachlorphenol	µg/kg	<5	<5	<5	<5	<5	<5	<5	<5
TPH	mg/kg	52	49	22	36	54	76	58	31
DEPH	mg/kg	0,45	0,4	0,32	0,32	0,27	0,5	0,17	0,23
Mercury	mg/kg	0,33	0,40	0,46	0,46	0,60	0,57	0,69	0,65
Arsenic	mg/kg	18,8	18,4	19,9	19,1	21,3	21,7	23,2	19,7
Cadmium	mg/kg	3,5	3,5	3,9	4,0	4,5	3,9	4,7	4,8
Lead	mg/kg	80	90	103	95	112	113	123	115
Copper	mg/kg	82	87	97	99	113	115	136	122
Zinc	mg/kg	350	365	391	376	416	392	466	437
Chromium	mg/kg	103	97	117	102	100	122	117	97
Nickel	mg/kg	97	95	94	88	98	100	91	90
Total phosphorus	mg/kg	1286	1582	1365	1470	1313	1332	1503	1387
Organic nitrogen	mg/kg	2321	2309	2305	2274	1986	2318	2297	2306

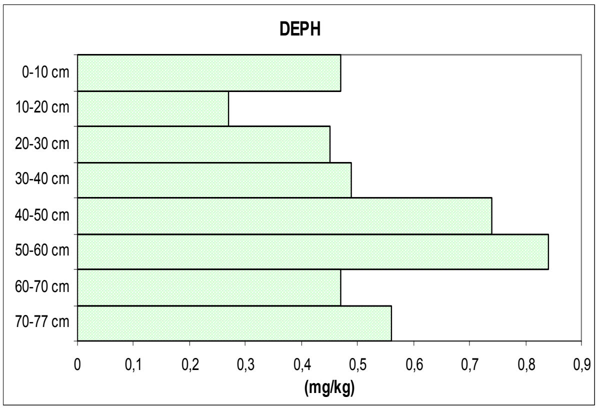
FIGURE 1. VERTICAL CONCENTRATION DISTRIBUTION OF DIFFERENT COMPONENTS IN CORE SAMPLE 1077 R

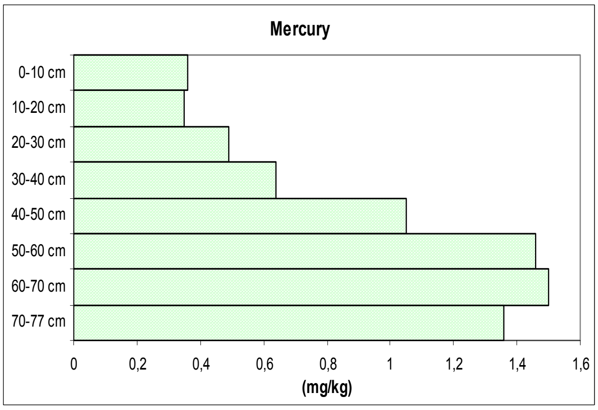


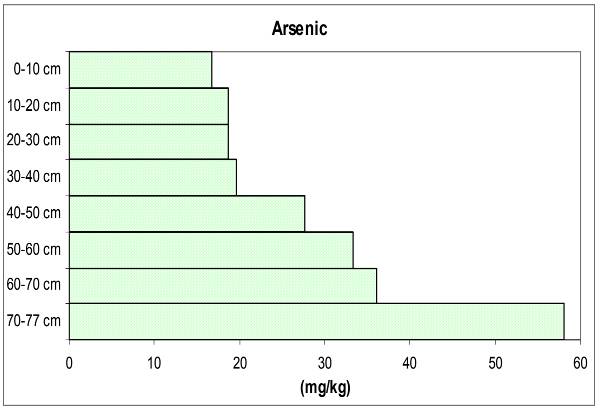

DDT
0-10 cm
10-20 cm
20-30 cm
30-40 cm
40-50 cm
50-60 cm
60-70 cm
70-77 cm
1
1,2
1,4
1,6
1,8
2
2,2
(µg/kg)

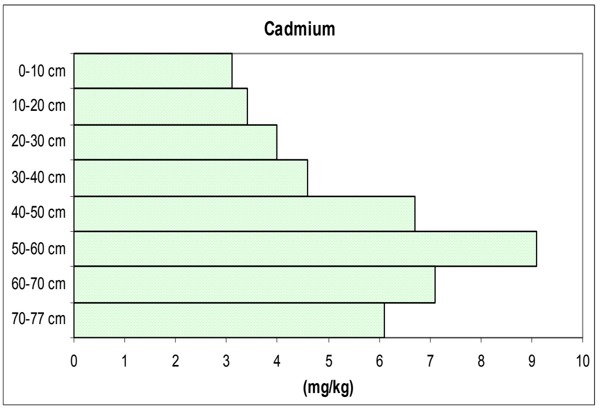

Nonyphenol
0-10 cm
10-20 cm
20-30 cm
30-40 cm
40-50 cm
50-60 cm
60-70 cm
70-77 cm
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
11000
(µg/kg)

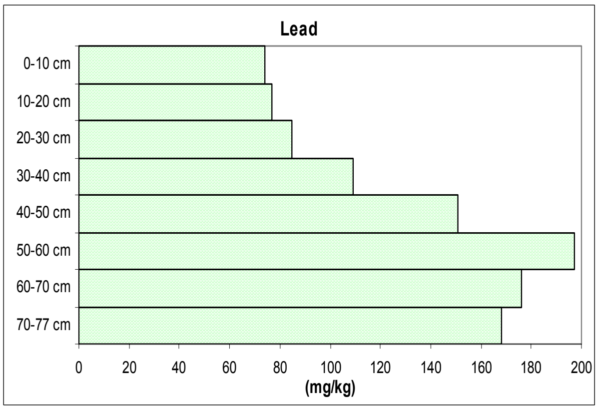

TPH
0-10 cm
10-20 cm
20-30 cm
30-40 cm
40-50 cm
50-60 cm
60-70 cm
70-77 cm
0
50
100
150
200
250
(mg/kg)

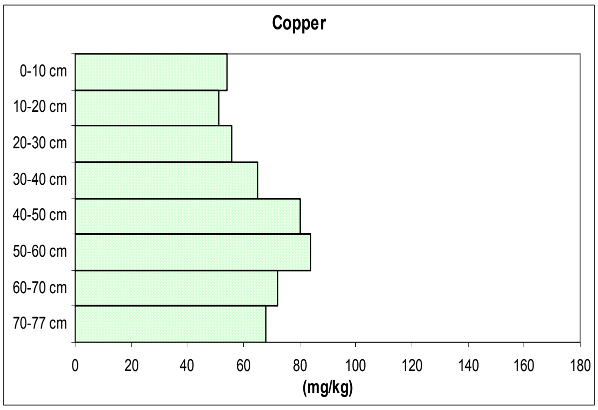

DEPH
0-10 cm
10-20 cm
20-30 cm
30-40 cm
40-50 cm
50-60 cm
60-70 cm
70-77 cm
0
0,1
0,2
0,3
0,4
0,5
0,6
0,7
0,8
0,9
(mg/kg)

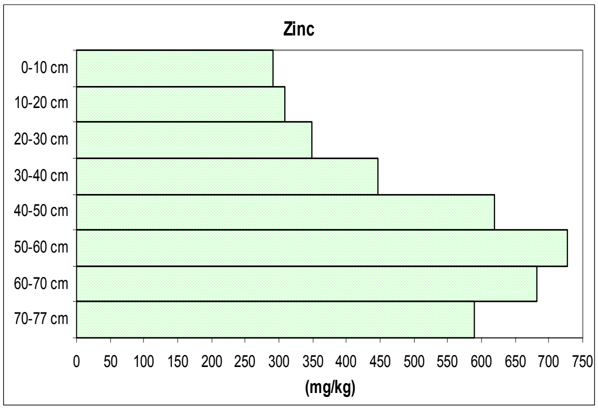

Mercury
0-10 cm
10-20 cm
20-30 cm
30-40 cm
40-50 cm
50-60 cm
60-70 cm
70-77 cm
0
0,2
0,4
0,6
0,8
1
1,2
1,4
1,6
(mg/kg)

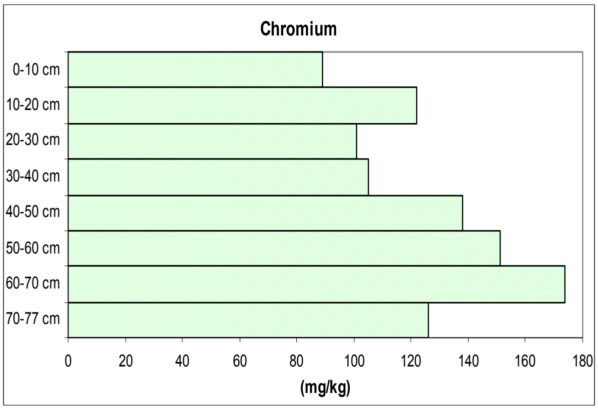

Arsenic
0-10 cm
10-20 cm
20-30 cm
30-40 cm
40-50 cm
50-60 cm
60-70 cm
70-77 cm
0
10
20
30
40
50
60
(mg/kg)

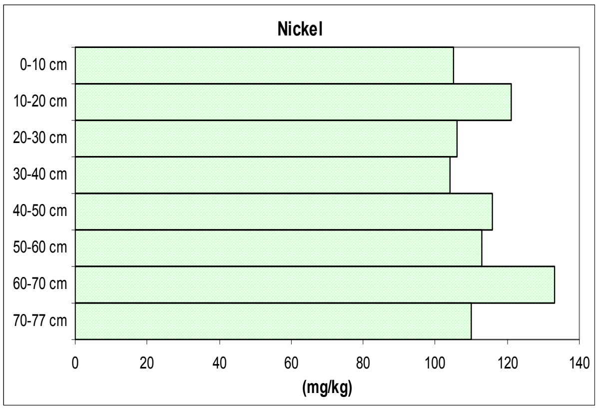

Cadmium
0-10 cm
10-20 cm
20-30 cm
30-40 cm
40-50 cm
50-60 cm
60-70 cm
70-77 cm
0
1
2
3
4
5
6
7
8
9
10
(mg/kg)

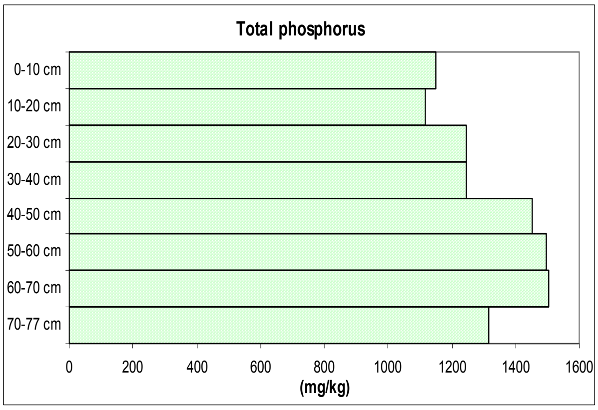

Lead
0-10 cm
10-20 cm
20-30 cm
30-40 cm
40-50 cm
50-60 cm
60-70 cm
70-77 cm
0 20 40 60 80 100 120 140 160 180 200
(mg/kg)


Copper
0-10 cm
10-20 cm
20-30 cm
30-40 cm
40-50 cm
50-60 cm
60-70 cm
70-77 cm
0 20 40 60 80 100 120 140 160 180
(mg/kg)


Zinc
0-10 cm
10-20 cm
20-30 cm
30-40 cm
40-50 cm
50-60 cm
60-70 cm
70-77 cm
0 50 100 150 200 250 300 350 400 450 500 550 600 650 700 750
(mg/kg)


Chromium
0-10 cm
10-20 cm
20-30 cm
30-40 cm
40-50 cm
50-60 cm
60-70 cm
70-77 cm
0 20 40 60 80 100 120 140 160 180
(mg/kg)


Nickel
0-10 cm
10-20 cm
20-30 cm
30-40 cm
40-50 cm
50-60 cm
60-70 cm
70-77 cm
0 20 40 60 80 100 120 140
(mg/kg)


Total phosphorus
0-10 cm
10-20 cm
20-30 cm
30-40 cm
40-50 cm
50-60 cm
60-70 cm
70-77 cm
0 200 400 600 800 1000 1200 1400 1600
(mg/kg)

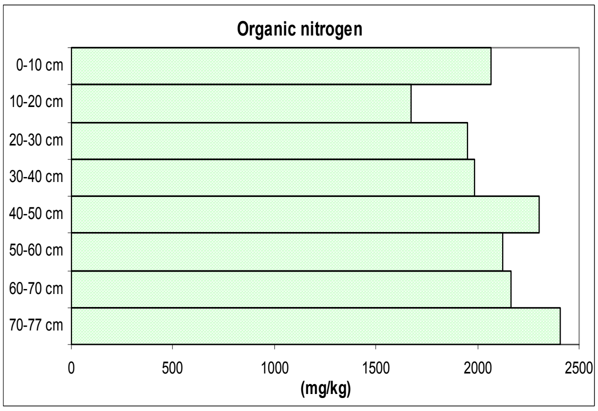
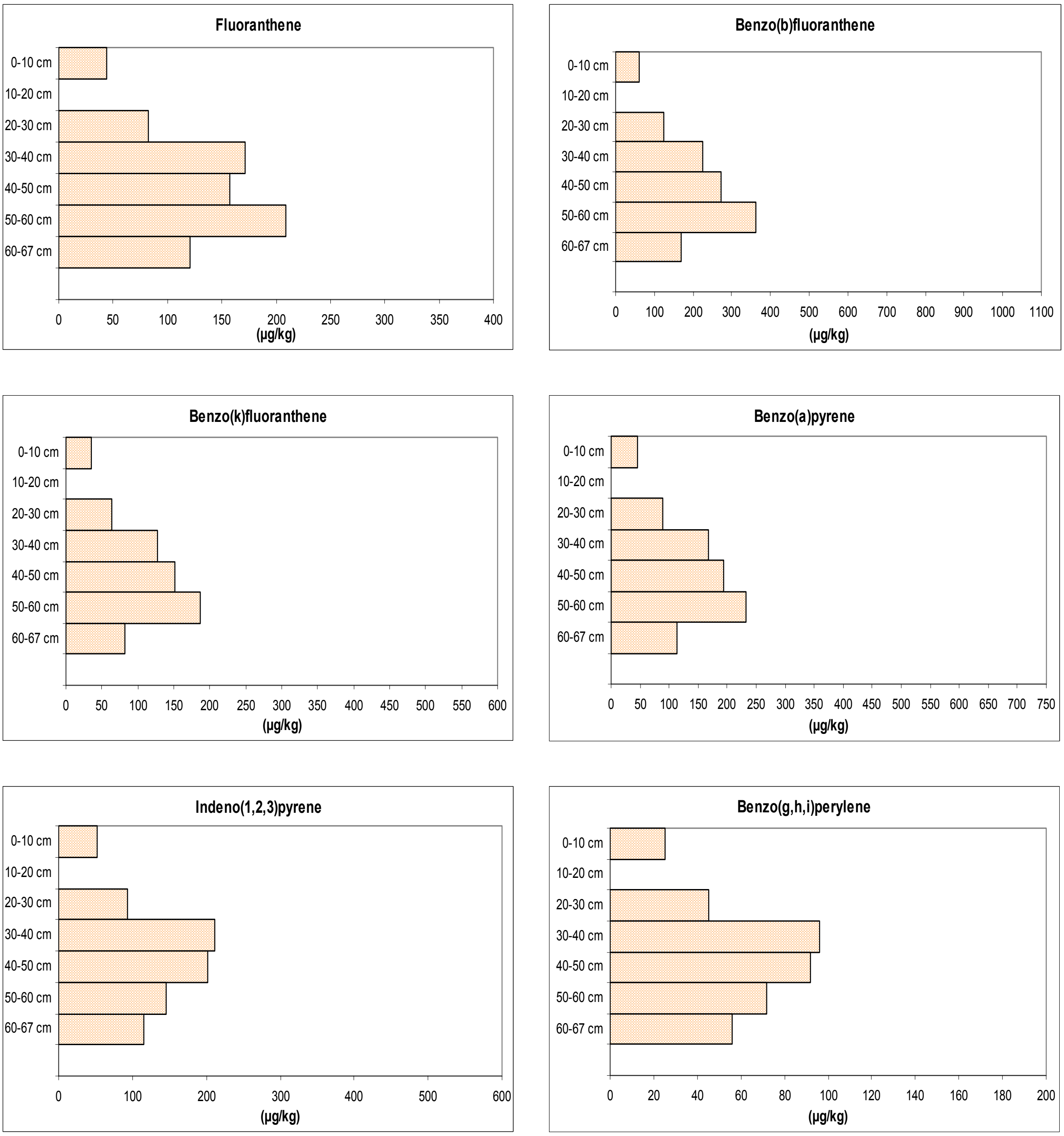
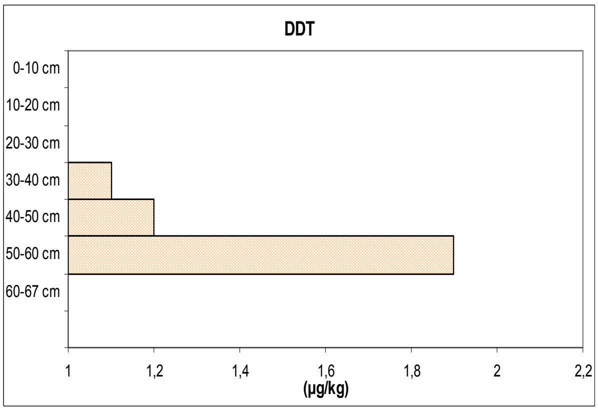
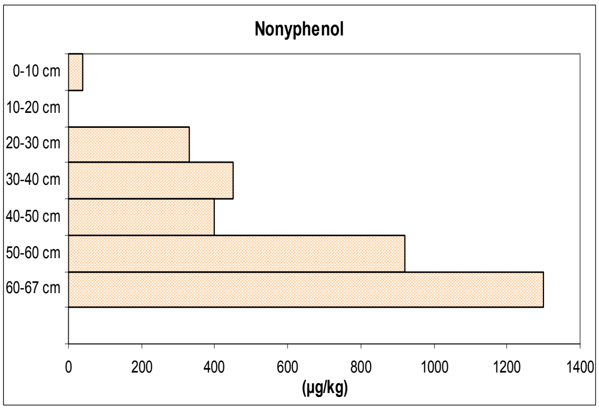
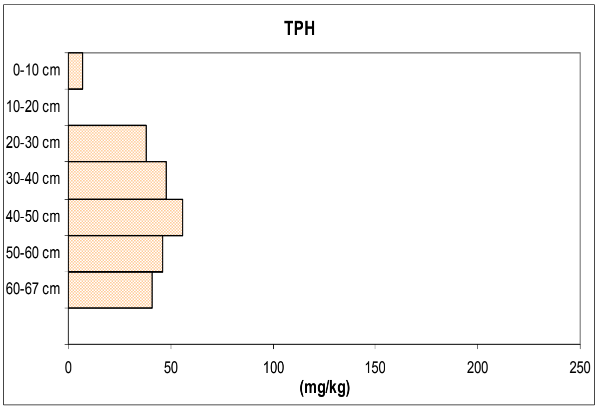

Organic nitrogen
0-10 cm
10-20 cm
20-30 cm
30-40 cm
40-50 cm
50-60 cm
60-70 cm
70-77 cm
0 500 1000 1500 2000 2500
(mg/kg)

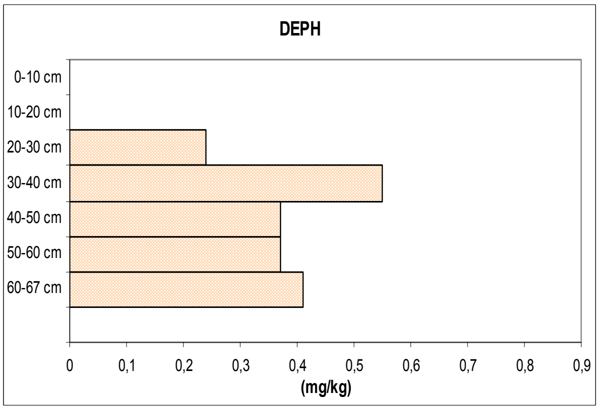
FIGURE 2. VERTICAL CONCENTRATION DISTRIBUTION OF DIFFERENT COMPONENTS IN CORE SAMPLE 991

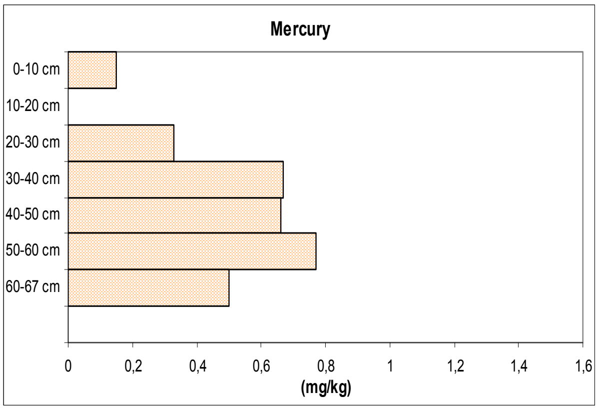


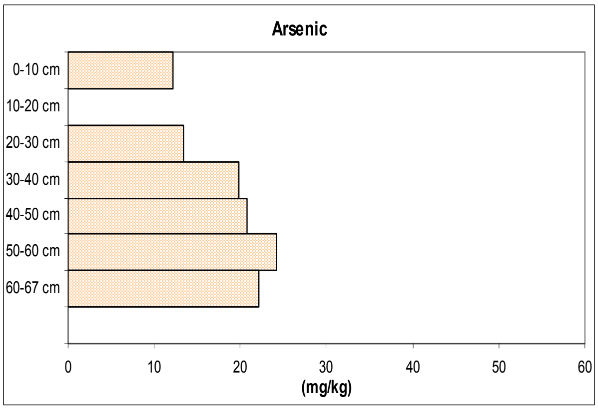

DDT
0-10 cm
10-20 cm
20-30 cm
30-40 cm
40-50 cm
50-60 cm
60-67 cm
1
1,2
1,4
1,6
1,8
2
2,2
(µg/kg)

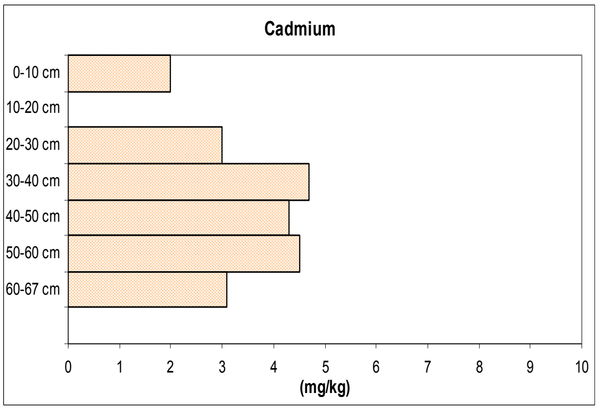

Nonyphenol
0-10 cm
10-20 cm
20-30 cm
30-40 cm
40-50 cm
50-60 cm
60-67 cm
0
200
400
600
800
1000
1200
1400
(µg/kg)

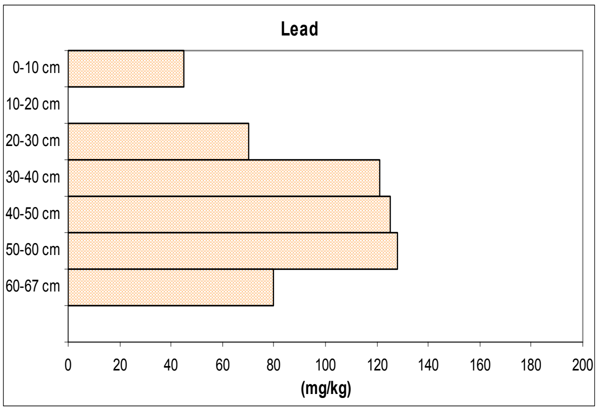

TPH
0-10 cm
10-20 cm
20-30 cm
30-40 cm
40-50 cm
50-60 cm
60-67 cm
0
50
100
150
200
250
(mg/kg)

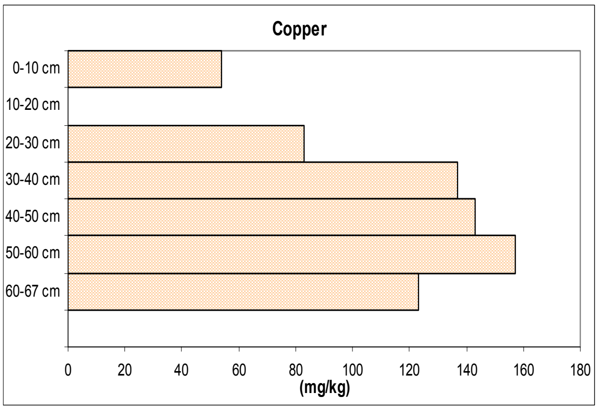

DEPH
0-10 cm
10-20 cm
20-30 cm
30-40 cm
40-50 cm
50-60 cm
60-67 cm
0
0,1
0,2
0,3
0,4
0,5
0,6
0,7
0,8
0,9
(mg/kg)

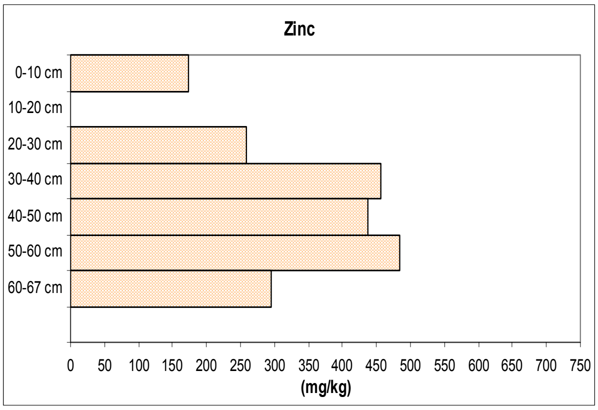

Mercury
0-10 cm
10-20 cm
20-30 cm
30-40 cm
40-50 cm
50-60 cm
60-67 cm
0
0,2
0,4
0,6
0,8
1
1,2
1,4
1,6
(mg/kg)

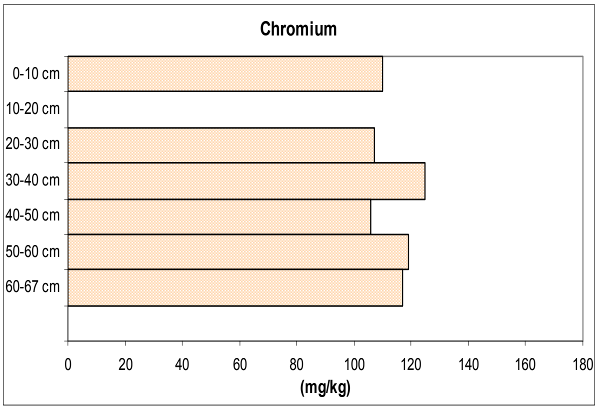

Arsenic
0-10 cm
10-20 cm
20-30 cm
30-40 cm
40-50 cm
50-60 cm
60-67 cm
0
10
20
30
40
50
60
(mg/kg)

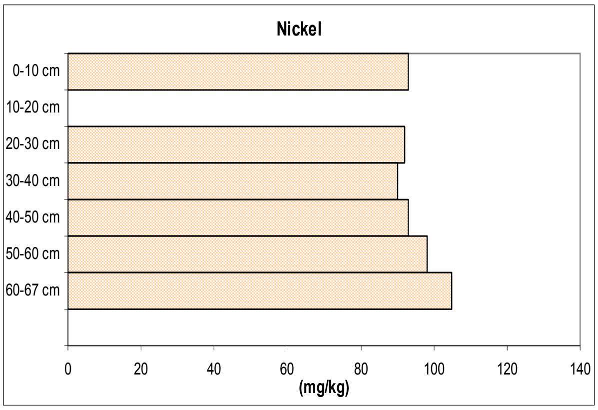

Cadmium
0-10 cm
10-20 cm
20-30 cm
30-40 cm
40-50 cm
50-60 cm
60-67 cm
0
1
2
3
4
5
6
7
8
9
10
(mg/kg)

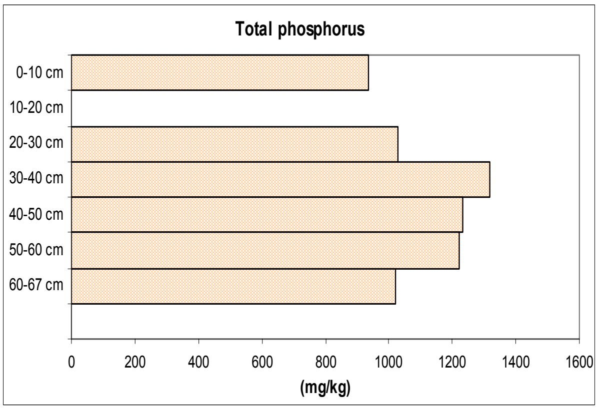

Lead
0-10 cm
10-20 cm
20-30 cm
30-40 cm
40-50 cm
50-60 cm
60-67 cm
0 20 40 60 80 100 120 140 160 180 200
(mg/kg)


Copper
0-10 cm
10-20 cm
20-30 cm
30-40 cm
40-50 cm
50-60 cm
60-67 cm
0 20 40 60 80 100 120 140 160 180
(mg/kg)


Zinc
0-10 cm
10-20 cm
20-30 cm
30-40 cm
40-50 cm
50-60 cm
60-67 cm
0 50 100 150 200 250 300 350 400 450 500 550 600 650 700 750
(mg/kg)


Chromium
0-10 cm
10-20 cm
20-30 cm
30-40 cm
40-50 cm
50-60 cm
60-67 cm
0 20 40 60 80 100 120 140 160 180
(mg/kg)


Nickel
0-10 cm
10-20 cm
20-30 cm
30-40 cm
40-50 cm
50-60 cm
60-67 cm
0 20 40 60 80 100 120 140
(mg/kg)


Total phosphorus
0-10 cm
10-20 cm
20-30 cm
30-40 cm
40-50 cm
50-60 cm
60-67 cm
0 200 400 600 800 1000 1200 1400 1600
(mg/kg)

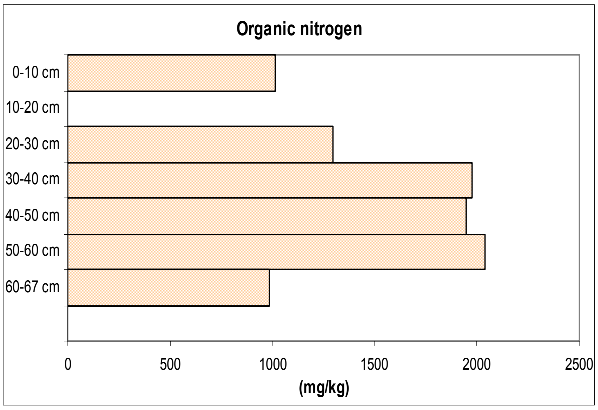
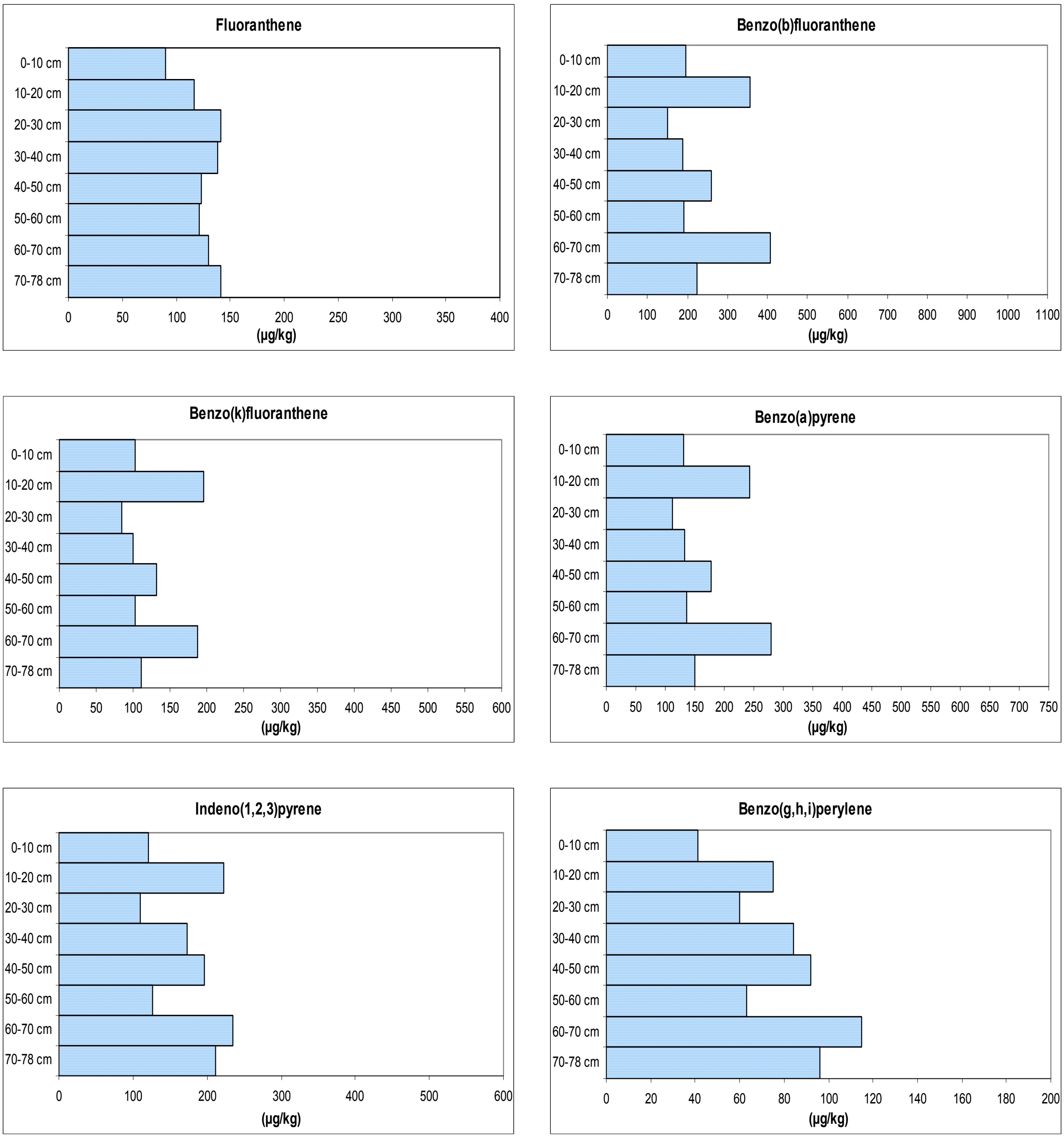
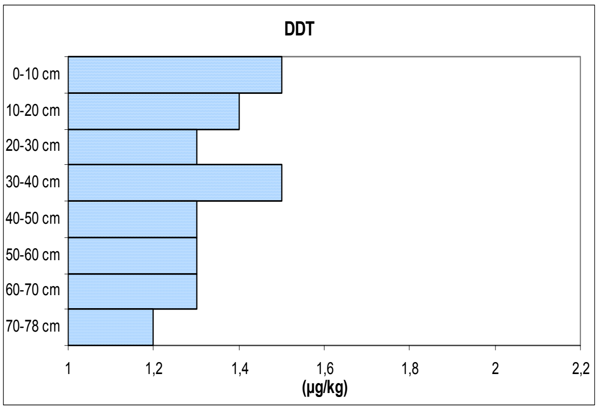
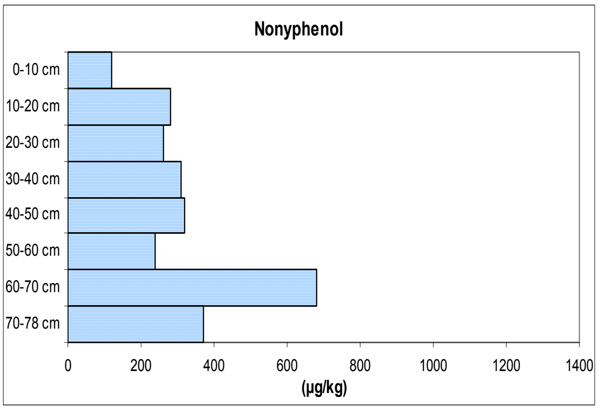
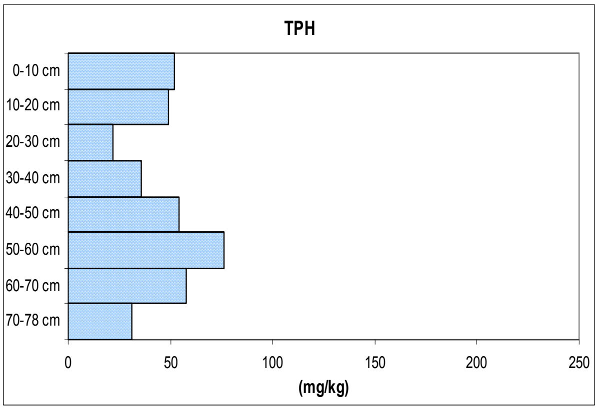

Organic nitrogen
0-10 cm
10-20 cm
20-30 cm
30-40 cm
40-50 cm
50-60 cm
60-67 cm
0 500 1000 1500 2000 2500
(mg/kg)

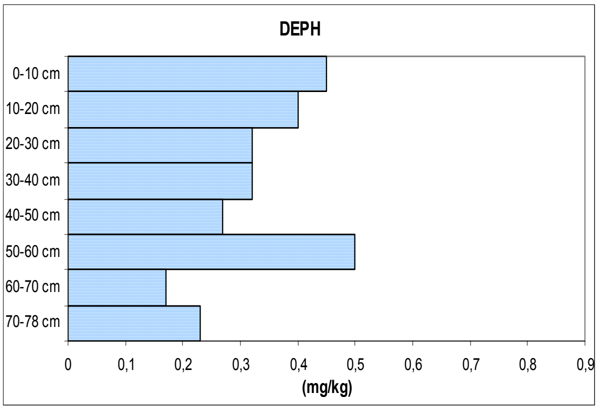
FIGURE 3. VERTICAL CONCENTRATION DISTRIBUTION OF DIFFERENT COMPONENTS IN CORE SAMPLE 956

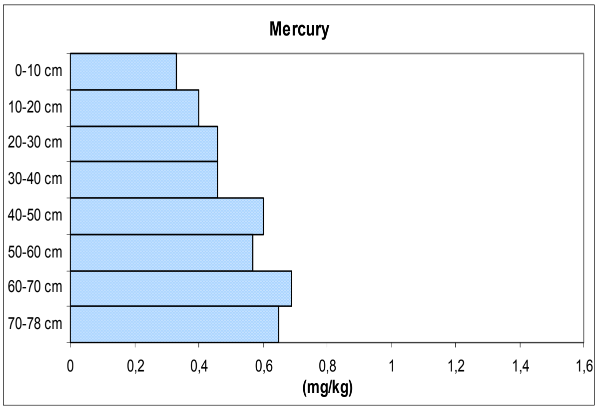


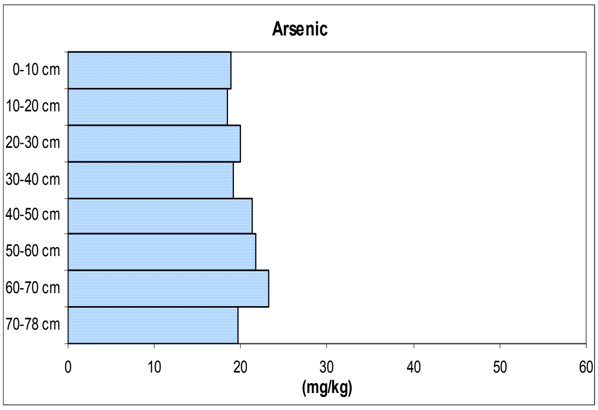

DDT
0-10 cm
10-20 cm
20-30 cm
30-40 cm
40-50 cm
50-60 cm
60-70 cm
70-78 cm
1 1,2 1,4 1,6 1,8 2 2,2
(µg/kg)

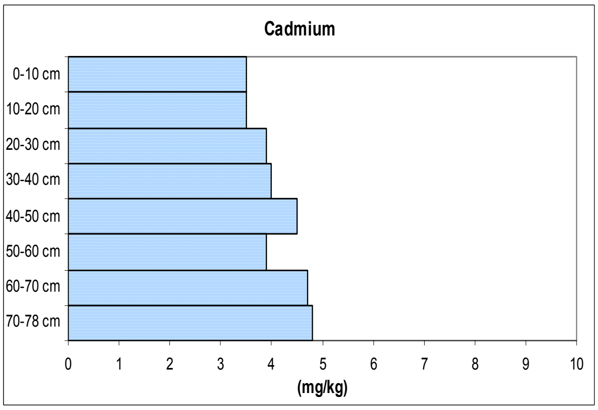

Nonyphenol
0-10 cm
10-20 cm
20-30 cm
30-40 cm
40-50 cm
50-60 cm
60-70 cm
70-78 cm
0 200 400 600 800 1000 1200 1400
(µg/kg)

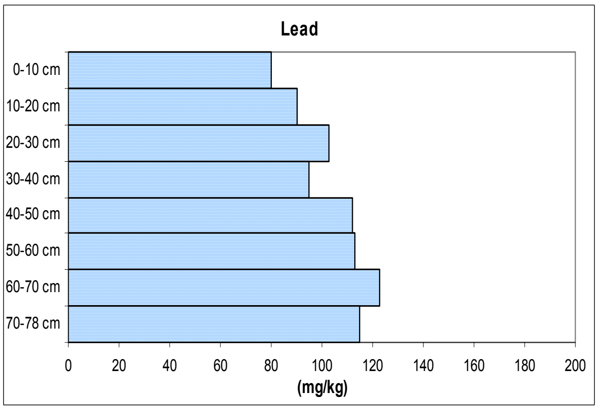

TPH
0-10 cm
10-20 cm
20-30 cm
30-40 cm
40-50 cm
50-60 cm
60-70 cm
70-78 cm
0 50 100 150 200 250
(mg/kg)

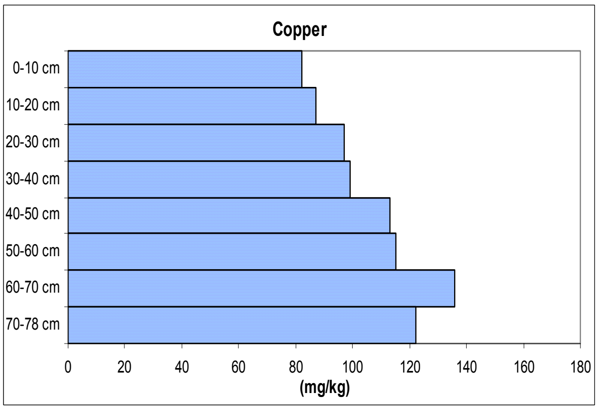

DEPH
0-10 cm
10-20 cm
20-30 cm
30-40 cm
40-50 cm
50-60 cm
60-70 cm
70-78 cm
0 0,1 0,2 0,3 0,4 0,5 0,6 0,7 0,8 0,9
(mg/kg)

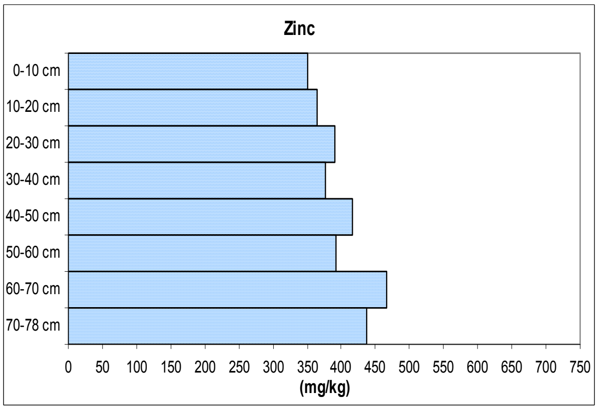

Mercury
0-10 cm
10-20 cm
20-30 cm
30-40 cm
40-50 cm
50-60 cm
60-70 cm
70-78 cm
0 0,2 0,4 0,6 0,8 1 1,2 1,4 1,6
(mg/kg)

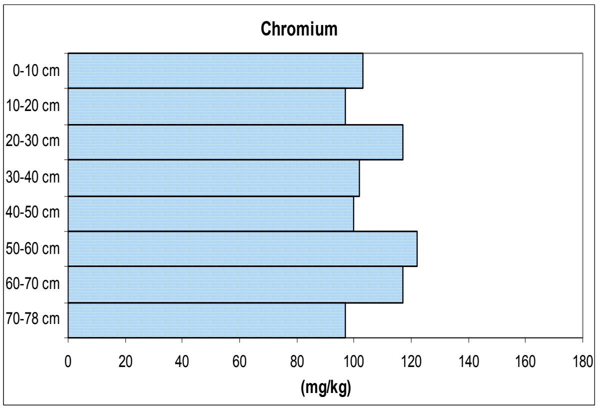

Arsenic
0-10 cm
10-20 cm
20-30 cm
30-40 cm
40-50 cm
50-60 cm
60-70 cm
70-78 cm
0 10 20 30 40 50 60
(mg/kg)

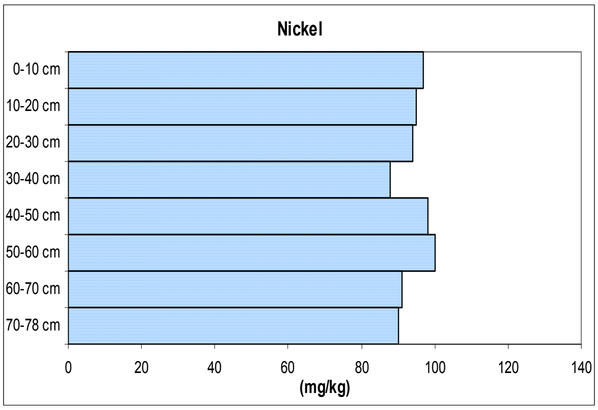

Cadmium
0-10 cm
10-20 cm
20-30 cm
30-40 cm
40-50 cm
50-60 cm
60-70 cm
70-78 cm
0 1 2 3 4 5 6 7 8 9 10
(mg/kg)

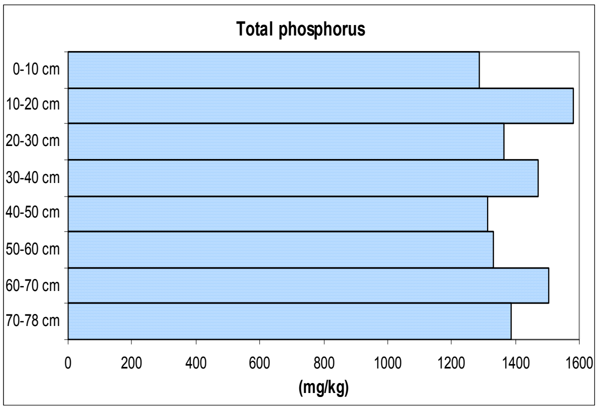

Lead
0-10 cm
10-20 cm
20-30 cm
30-40 cm
40-50 cm
50-60 cm
60-70 cm
70-78 cm
0 20 40 60 80 100 120 140 160 180 200
(mg/kg)


Copper
0-10 cm
10-20 cm
20-30 cm
30-40 cm
40-50 cm
50-60 cm
60-70 cm
70-78 cm
0 20 40 60 80 100 120 140 160 180
(mg/kg)


Zinc
0-10 cm
10-20 cm
20-30 cm
30-40 cm
40-50 cm
50-60 cm
60-70 cm
70-78 cm
0 50 100 150 200 250 300 350 400 450 500 550 600 650 700 750
(mg/kg)


Chromium
0-10 cm
10-20 cm
20-30 cm
30-40 cm
40-50 cm
50-60 cm
60-70 cm
70-78 cm
0 20 40 60 80 100 120 140 160 180
(mg/kg)


Nickel
0-10 cm
10-20 cm
20-30 cm
30-40 cm
40-50 cm
50-60 cm
60-70 cm
70-78 cm
0 20 40 60 80 100 120 140
(mg/kg)


Total phosphorus
0-10 cm
10-20 cm
20-30 cm
30-40 cm
40-50 cm
50-60 cm
60-70 cm
70-78 cm
0 200 400 600 800 1000 1200 1400 1600
(mg/kg)

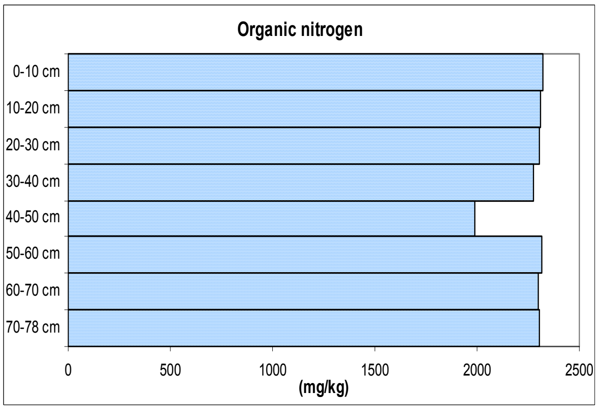
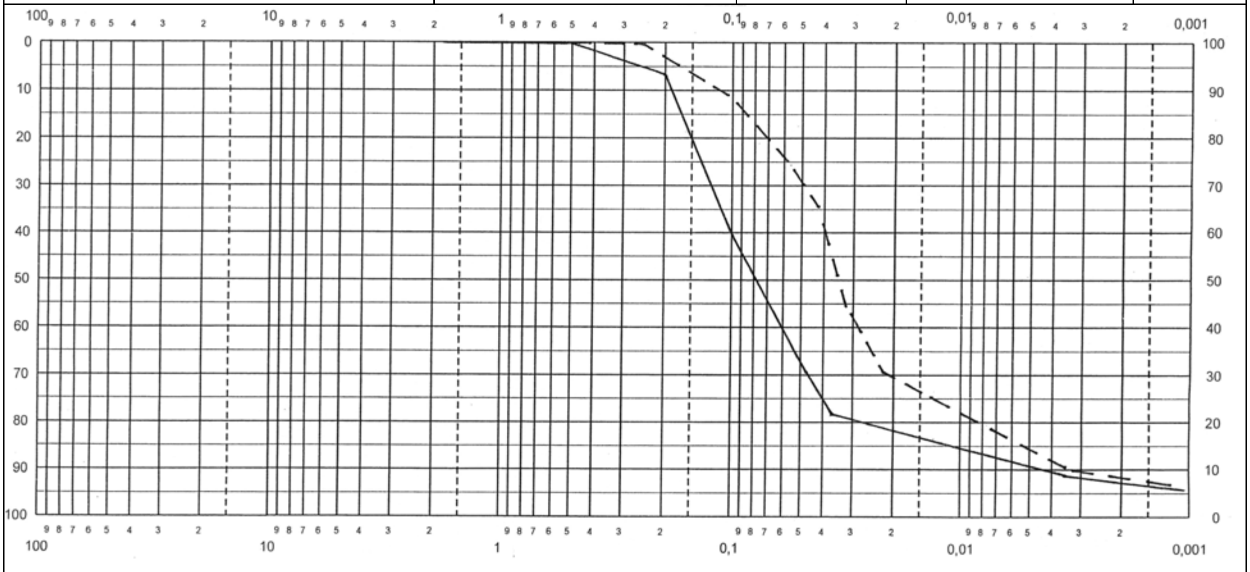

Organic nitrogen
0-10 cm
10-20 cm
20-30 cm
30-40 cm
40-50 cm
50-60 cm
60-70 cm
70-78 cm
0 500 1000 1500 2000 2500
(mg/kg)

FIGURE 4. PRACTICLE SIZE DISTRIBUTION OF SEDIMENT SAMPLES

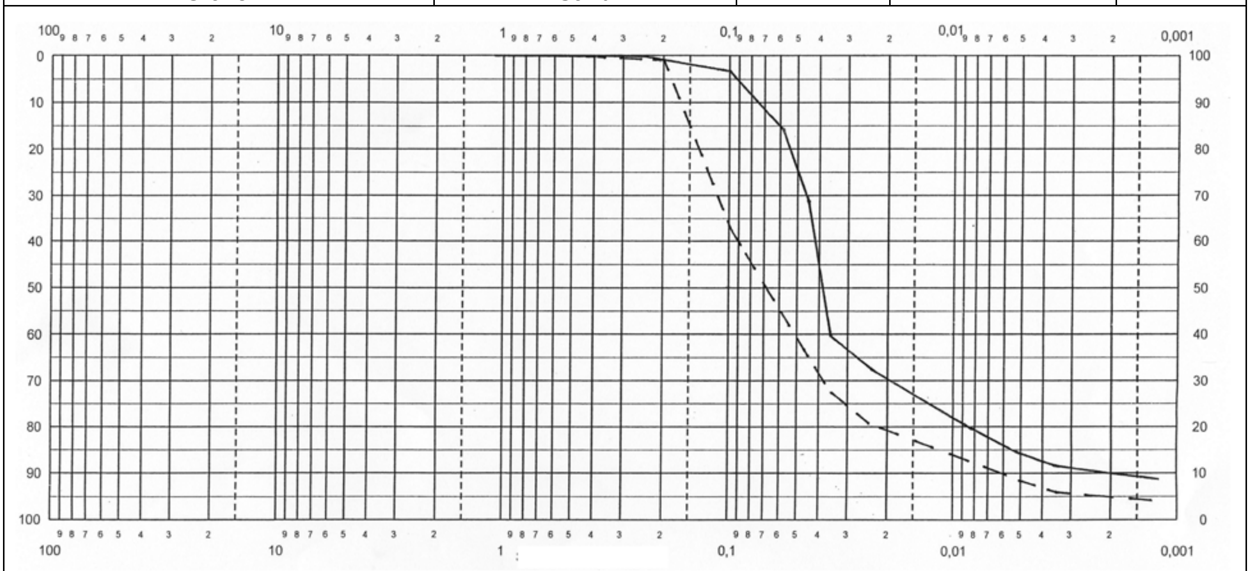
Crude	Tiny	Crude	Middle	Fine	Sandflour	Silt	Loam
Gravel		Sand					



grain size d(mm)

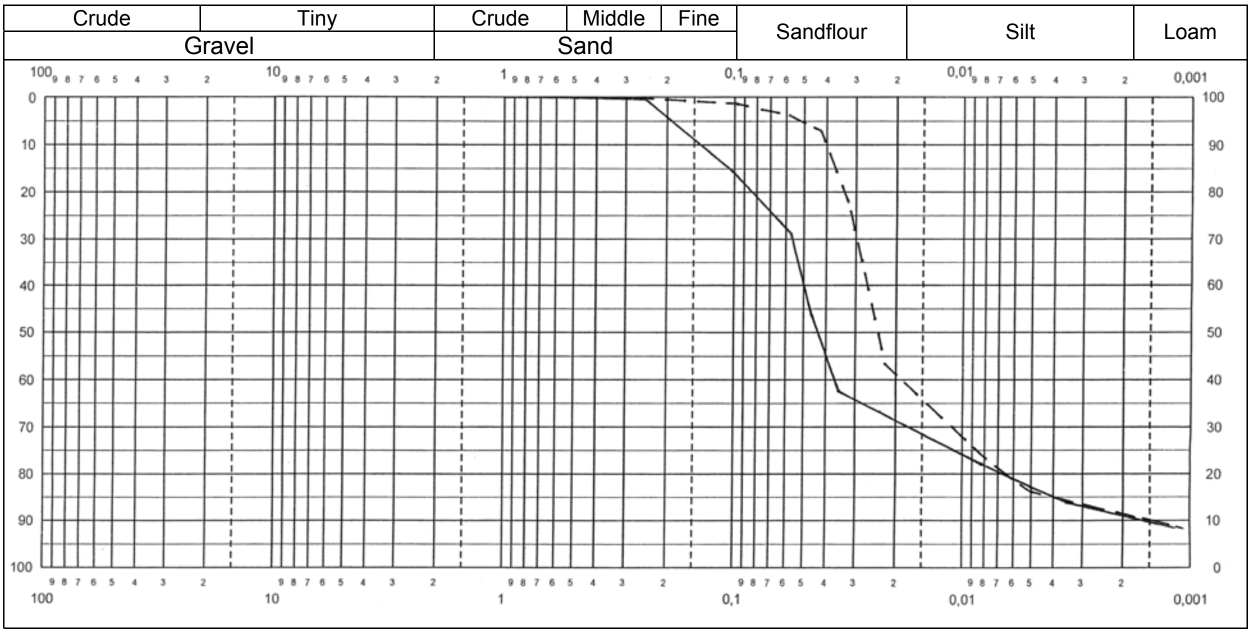
Sample code	D_{60}	D_{10}	U	Marking
1-1107 R-HU	0,1	0,0043	23,3	————————
L-HU	0,040	0,0034	11,8	- - - - - - - - - - - - - - -

Crude	Tiny	Crude	Middle	Fine	Sandflour	Silt	Loam
Gravel		Sand					



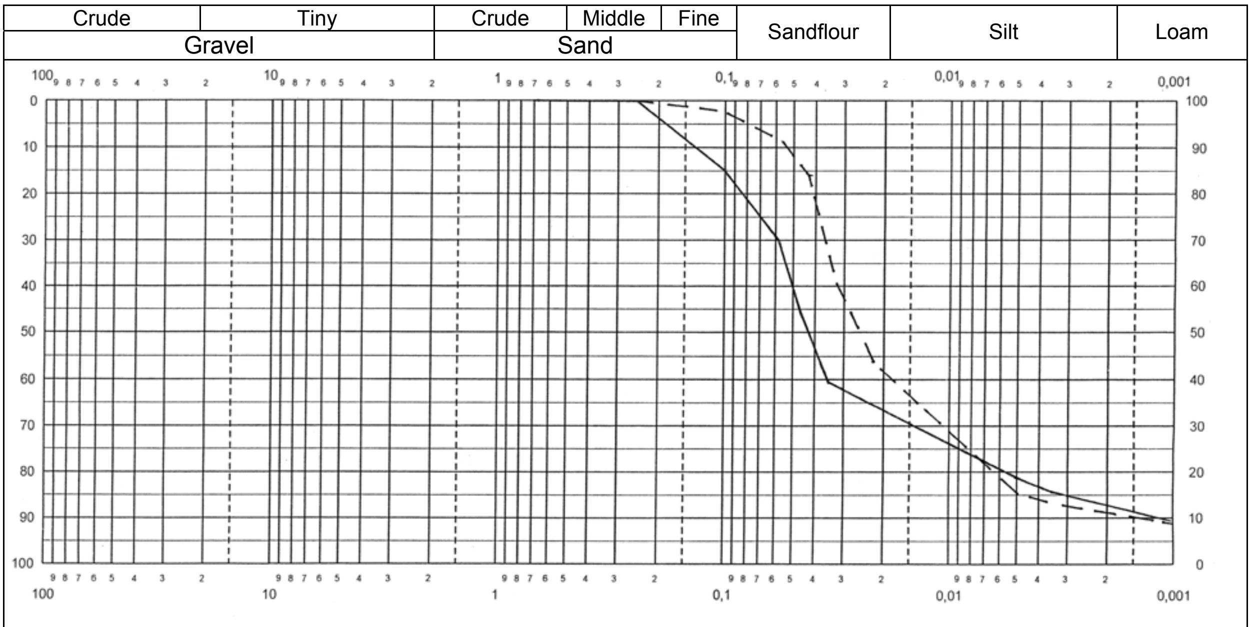
grain size d(mm)

Sample code	D_{60}	D_{10}	U	Marking
2-1097 R-HU	0,041	0,0020	20,5	————————
L-HU	0,090	0,0060	15,0	- - - - - - - - - - - - - - -



grain size d(mm)

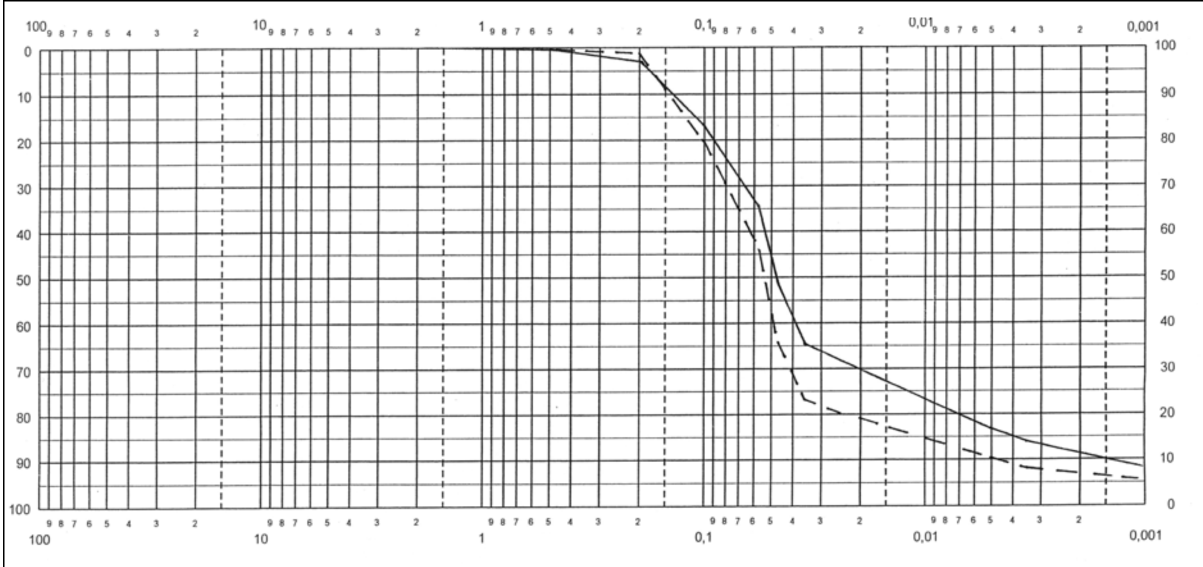
Sample code	D_{60}	D_{10}	U	Marking
3-1072 R-HU	0,050	0,0016	31,3	————————
L-HU	0,026	0,0015	17,3	----------------



grain size d(mm)

Sample code	D_{60}	D_{10}	U	Marking
4-1061 R-HU	0,050	0,0012	41,7	————————
L-HU	0,032	0,0014	22,9	----------------

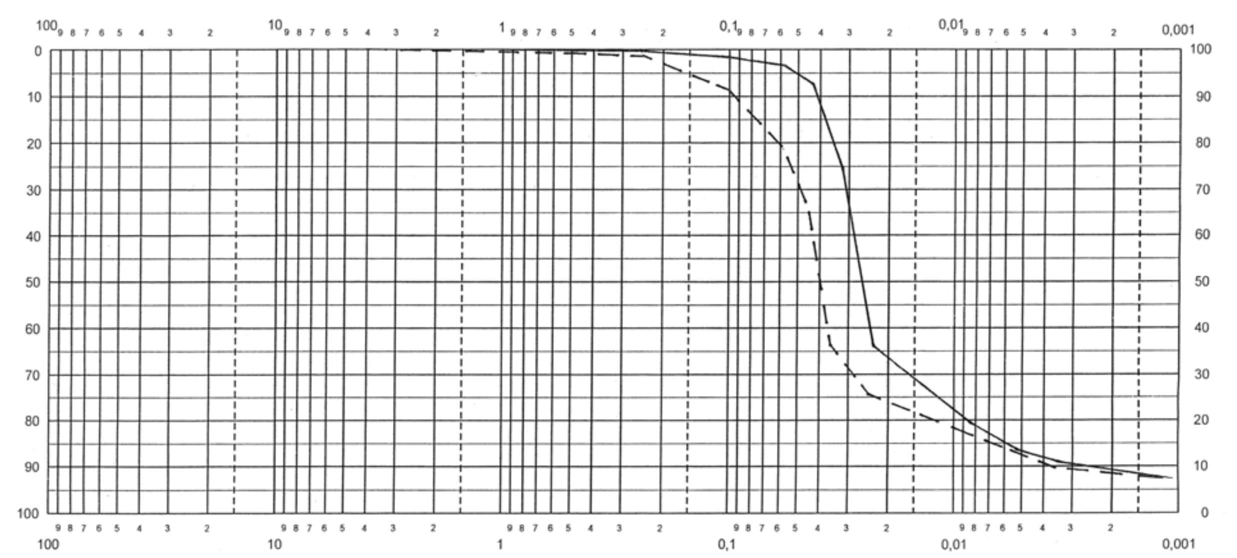
Crude	Tiny	Crude	Middle	Fine	Sandflour	Silt	Loam
Gravel		Sand					



grain size d(mm)

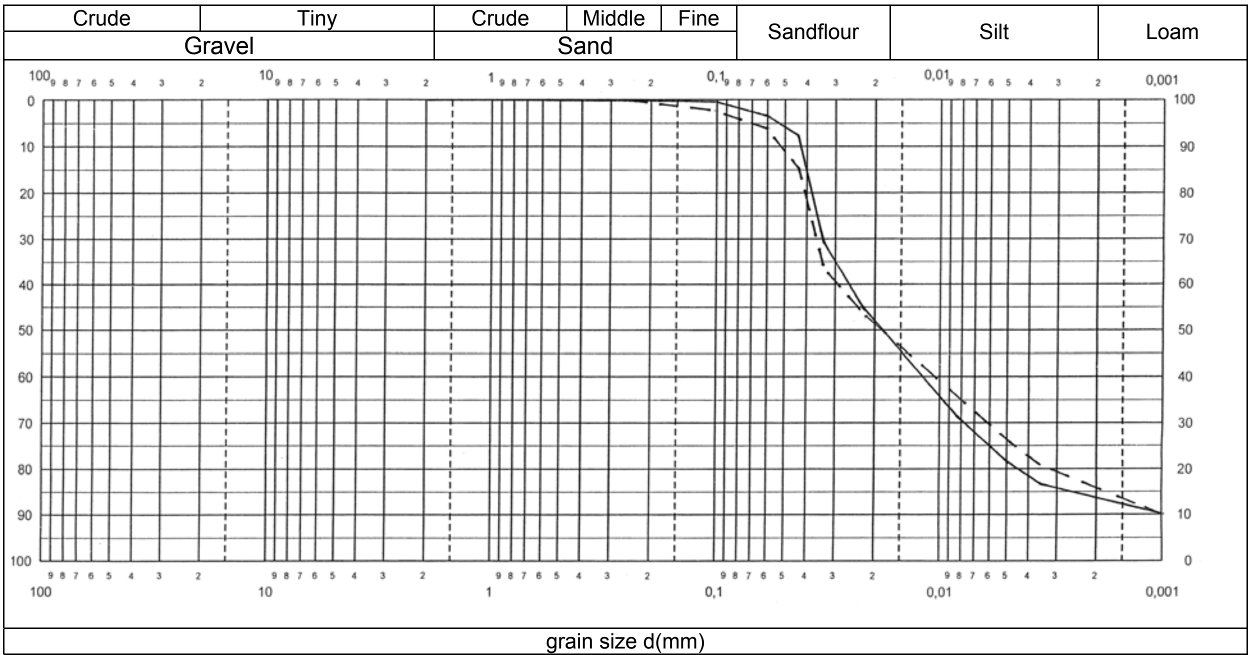
Sample code	D_{60}	D_{10}	U	Marking
5-1040 R-HU	0,053	0,0015	35,3	————————
L-HU	0,062	0,0048	12,9	----------------

Crude	Tiny	Crude	Middle	Fine	Sandflour	Silt	Loam
Gravel		Sand					

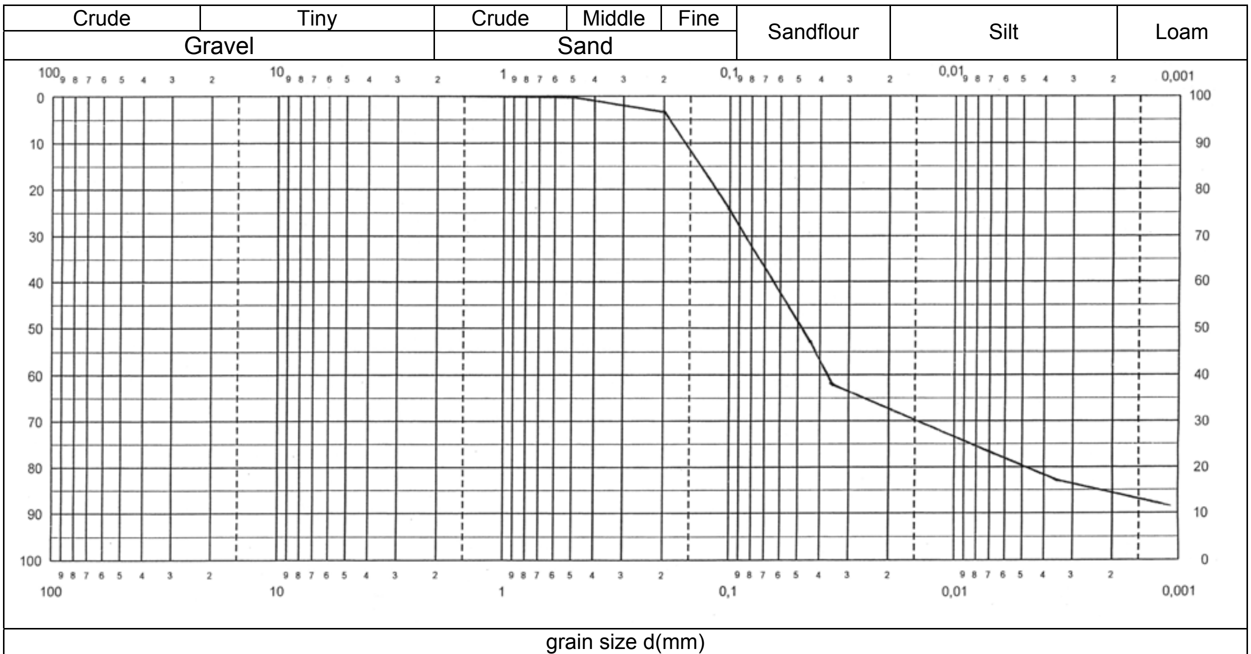


grain size d(mm)

Sample code	D_{60}	D_{10}	U	Marking
6-1022 R-HU	0,028	0,0026	10,8	————————
L-HU	0,043	0,0037	11,6	----------------

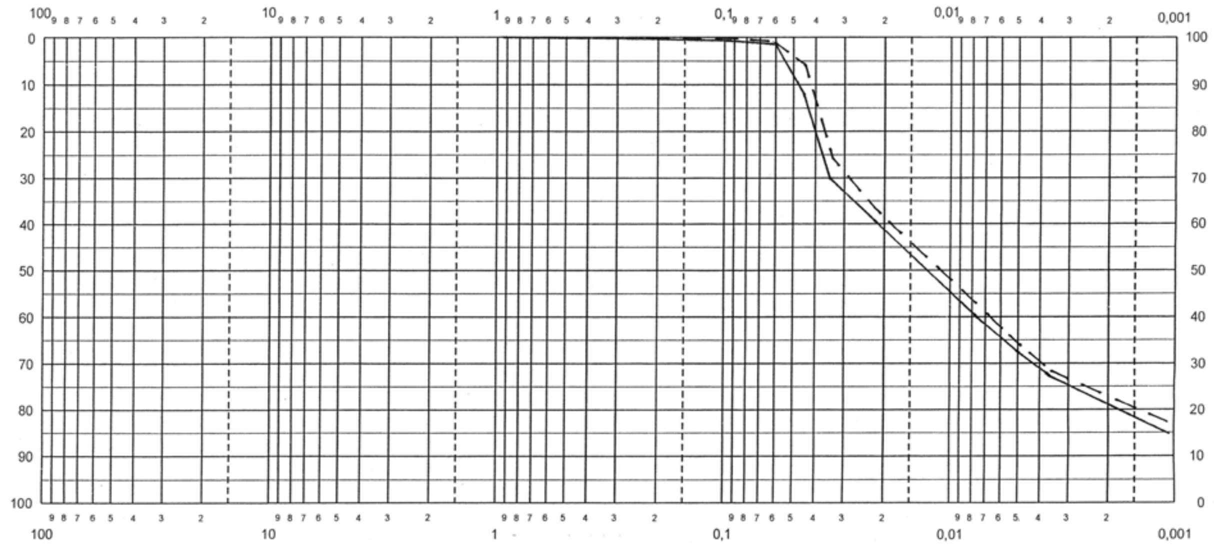


Sample code	D_{60}	D_{10}	U	Marking
7-990 R-HU	0,026	0,0010	26,0	————————
L-HU	0,030	0,0010	30,0	----------------



Sample code	D_{60}	D_{10}	U	Marking
8-971 R-HU	0,064	< 0,0010	> 64,0	————————

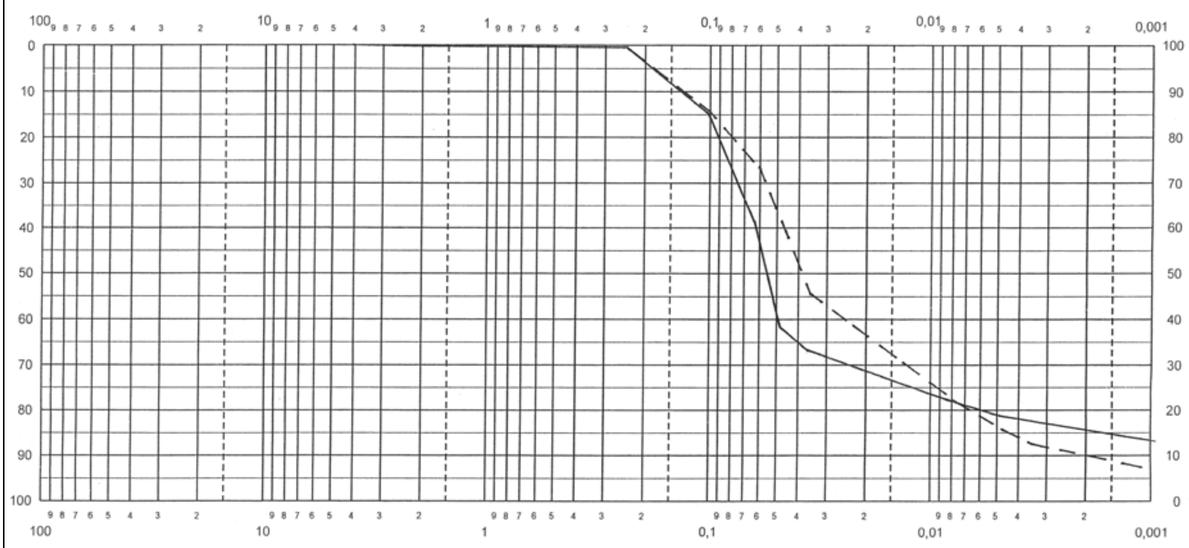
Crude	Tiny	Crude	Middle	Fine	Sandflour	Silt	Loam
Gravel		Sand					



grain size d(mm)

Sample code	D_{60}	D_{10}	U	Marking
9-956 R-HU	0,021	< 0,0010	> 21,0	———————
L-HU	0,018	< 0,0010	> 18,0	---------------

Crude	Tiny	Crude	Middle	Fine	Sandflour	Silt	Loam
Gravel		Sand					



grain size d(mm)

Sample code	D_{60}	D_{10}	U	Marking
10-924 R-HU	0,061	< 0,0010	> 61,0	———————
L-HU	0,046	0,0020	23,0	---------------

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