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ENGLAND GEOSYSTEM
ENVIRONMENTAL ENGINEERING

HALEY & ALDRICH

BOEING REALTY CORPORATION
FORMER C-6 FACILITY
LOS ANGELES, CALIFORNIA

SAMPLING AND ANAYLYSIS PLAN SUPPLEMENT NO. 5

FIELD ACTION LEVELS FOR SOIL
PARCEL C

To: **Mr. Brian Mossman**
Boeing Realty Corporation
3760 Kilroy Airport Way, Suite 500
Long Beach, CA 90806

From: **Haley & Aldrich, Inc.**

Date: **March 6, 2001**

Re: **Sampling and Analysis Supplement, Field Action Levels for Soils, Boeing Realty Corporation Former C-6 Facility – Parcel C, Los Angeles, California**

Haley & Aldrich, Inc. is herein providing this technical memorandum as Supplement No. 5 to the August 16, 2000 *Sampling and Analysis Plan* (SAP), prepared by Kennedy/Jenks Consultants (K/J) for Boeing Realty Corporation's (BRC's) Former C-6 Facility – Parcel C, Los Angeles, California (subject parcel). This Supplement No. 5 describes the derivation and use of chemical concentration Field Action Levels (FALs) for soil in effect at the subject parcel.

PURPOSE

FALs have been derived for use as a tool to assist with the assessment of soil impact delineation. The FALs are being used to evaluate whether additional soil "step out" sampling is required for further delineation of soil concentrations.

FIELD ACTION LEVELS

FALs are human health risk-based values that have been derived for individually for organic and inorganic chemical analytes that may be present in soil. The FALs have been developed using conservative assumptions, such that if soil concentrations are less than the FALs, it is likely that no further action would be required by the regulatory agencies for soil concentrations to be protective of public health or protective of potential groundwater degradation. If chemical concentrations at the limits of the soil impacts are greater than the FALs, it is recommended that additional "step-out" soil samples be obtained. Thus, if chemical concentrations in collected soil samples have been delineated both horizontally and vertically to values at or less than the FALs, and a decreasing concentration trend is present, the environmental target or area of concern can be deemed as adequately characterized. Potential human health risks associated with possible exposure to site-related contaminants will be evaluated for each area of environmental concern as described in the November 29, 2000 Risk Assessment Workplan (RAWP) for the subject parcel.

The procedures for deriving FALs for petroleum hydrocarbon mixtures, individual organic chemicals, and inorganic chemicals are described in this supplement.

FALs for Organic and Inorganic Chemicals

The procedure for deriving FALs for organic and inorganic chemicals is also summarized in Figure 1. Since future onsite land use will be either commercial or light industrial, FALs were developed for those potential land use scenarios. FALs for organic and inorganic chemicals were based on cancer and noncancer United States Environmental Protection Agency (USEPA) (1999) Region 9 soil preliminary remediation goals (PRGs) and USEPA (1996) soil screening levels (SSLs), revised to reflect California Environmental Protection Agency (Cal-EPA) toxicity values. PRGs were selected to protect public health from direct soil contact (soil ingestion, inhalation, and dermal contact) in commercial and light industrial land use settings. SSLs were selected to protect groundwater resources. SSLs are derived using conservative assumptions, and do not account for natural degradation of compounds.

Since the acceptable risk thresholds identified in the November 29, 2000 Risk Assessment Work Plan are an excess lifetime cancer risk of $1x10^{-5}$ and a hazard index of 1.0, the FALs have been developed to address possible compound additivity of adverse health effects when conducting the risk assessments. For noncarcinogenic chemicals, additive noncarcinogenic hazards are typically considered only for those chemicals with the same toxic endpoint or mechanism of action. A "safety factor" of three was applied to the PRGs and SSLs for noncarcinogens to account for an estimate of possible cumulative noncancer effects of multiple chemicals potentially present in soils. No safety factor for carcinogens was used; rather, it was incorporated into the risk level chosen for calculating the FAL. The PRGs and generally the SSLs for carcinogens are based on a conservative acceptable risk of 10^{-6}.

After the PRGs and SSLs were identified, a preliminary FAL for each chemical was selected as the lower of the adjusted PRG and SSL. For inorganic chemicals, the preliminary FAL was compared to the preliminary maximum background concentration or the laboratory reported detection limit (RDL). From this comparison, the higher of the background concentration, the RDL, or the preliminary FAL was selected as the final FAL. For organic chemicals, the preliminary FAL was selected as the FAL unless the value was less than the RDL. In such a case, the RDL was selected as the FAL.

The preliminary maximum background concentration for each inorganic chemical was estimated by plotting each metal's data from soil samples collected from Parcels A, B, and D in increasing concentration order. Each data graph (plot) was evaluated to identify the concentration at which the data diverge (i.e., the point at which the best-fit line of each of two data sets, a background data set and an impacted data set, bisects). This point-of-departure concentration was then compared to background concentrations presented in the literature for southern California to further assess whether it appears to be a reasonable estimate of the maximum background concentration. The point-of-departure concentration was identified as the preliminary background concentration if the point-of-departure concentration is within the range of background concentrations in the literature. The highest reported site-specific concentration was identified as the preliminary maximum concentration if (1) there did not appear to be a point-of-departure, or (2) the concentration associated with the apparent point-of-departure is lower than the literature values. A copy of the background data graphs and list of identified preliminary maximum background concentrations are presented in Attachment 1. The selected FALs are presented in Table 1.

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FALs for Petroleum Mixtures

FALs were derived for various petroleum hydrocarbon mixtures, in addition to the FALs for the individual chemicals within mixtures of petroleum hydrocarbons. The mixture FALs were derived based on conservatively calculated residual saturation capacity concentrations for the specified petroleum mixture for representative onsite soils, considered to be silty sand. Residual saturation capacity is the concentration above which sufficient free product (nonaqueous-phase liquid [NAPL]) is present in the soil matrix to allow for product migration from gravity flow through the soil column. Below the residual saturation capacity concentration, NAPL loses pore continuity in the soil matrix and becomes trapped by soil capillary forces, and movement of NAPL is considered insignificant. The mixture FALs are considered to be conservative since in order to generate free product on the groundwater table the average petroleum hydrocarbon mixture concentration over entire soil column would have to exceed the mixture FALs. The calculated FALs (residual saturation capacity concentrations) for various petroleum hydrocarbon mixtures are presented in Table 2. It should be noted that both the FALs for the individual organic and inorganic chemicals and the mixture FALs must be met for petroleum hydrocarbon mixtures before a decision of no further assessment can be made.

Sincerely yours,
HALEY & ALDRICH, INC.

Anita Broughton, CIH
Risk Assessment Task Manager

Scott Zachary
Vice President and Project Manager
Industrial Environmental Group

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ANITA BRENCE BROUGHTON, CIH

Attachments:

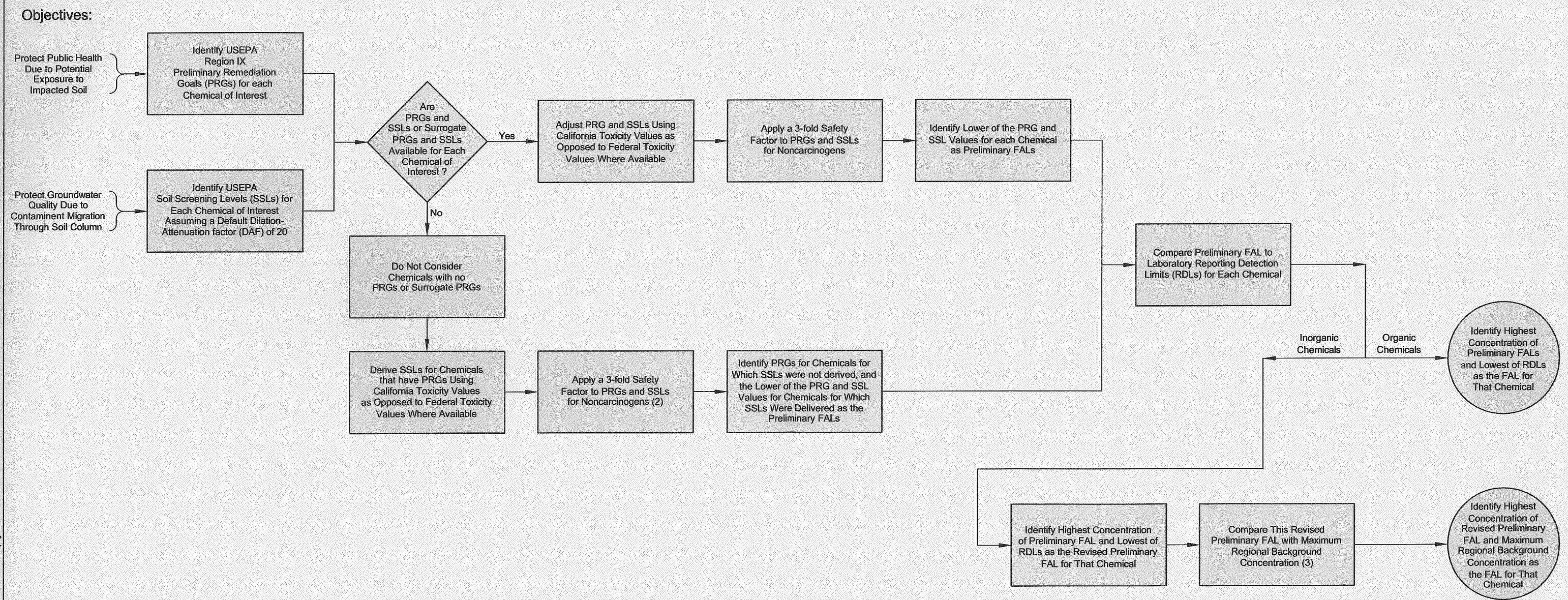
Figure 1	Field Action Level Derivation for Soil
Table 1	FALs for Organic and Inorganic Chemicals
Table 2	FALs for Petroleum Hydrocarbon Mixtures
Appendix A	Preliminary Maximum Background Metals Concentrations in Soil and Associated Data Graphs

BOE-C6-0232094

Figures

BOE-C6-0232095

GOAL: DERIVE ACTION LEVEL GUIDLINES FOR FIELD USE TO ASSIST WITH THE EVALUATION OF SUFFICIENT SAMPLING AND ANALYTICAL DATA FOR USE IN CONDUCTING A RISK ASSESMENT. (1)



(1) FALs WERE DEVELOPED FOR A FUTURE COMMERCIAL AND LIGHT INDUSTRIAL LAND USE SCENARIO ONLY.

(2) NO SAFETY FACTOR IS APPLIED TO PRGs AND SSLs FOR CARCINOGENS SINCE THEIR DERIVATION IS GENERALLY BASED ON CONSERVATIVE ACCEPTABLE RISK THRESHOLD OF 1 X 10^{-6}.

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FIGURE 1: FIELD ACTION LEVEL DERIVATION FOR SOIL

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G:\Projects\ENVIRONMENTAL\Boeing\C-6\Parcel C\sSAP Addendum\Figure 1 - Field Action Level Derivation For Soil.DWG 6 March 2001 13:10

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Tables

BOE-C6-0232097

Table 1 (Page 1 of 3)
Soil Field Action Levels for Organic and Inorganic Chemicals

Boeing Reality Corporation, Former C-6 Facility

Chemical	CAS No.	Industrial Soil FAL (mg/kg)	Basis
METALS			
ALUMINUM	7429-90-5	2.7E+04	Background
ANTIMONY	7440-36-0	1.4E+01	SSL
ARSENIC	7440-38-2	8.0E+00	Background
BARIUM	7440-39-3	6.3E+02	SSL
BERYLLIUM	7440-41-7	3.1E+02	SSL
CADMIUM	7440-43-9	2.7E+01	SSL
CHROMIUM	7440-47-3	3.8E+01	SSL
COBALT	7440-48-4	9.4E+00	Background
COPPER	7440-50-8	2.0E+01	Background
LEAD	7439-92-1	8.0E+00	Background
MERCURY	7487-94-7	1.1E+01	SSL
MOLYBDENUM	7439-98-7	4.0E+00	RDL
NICKEL	7440-02-0	9.5E+02	SSL
SELENIUM	7782-49-2	1.0E+01	SSL
SILVER	7440-22-4	3.1E+01	SSL
THALLIUM	7440-28-0	7.0E-01	SSL
VANADIUM	7440-62-2	4.8E+03	Noncancer PRG
ZINC	7440-66-6	4.2E+03	SSL
HEXAVALENT CHROMIUM	18540-29-9	3.8E+01	SSL
POLYCHLORINATED BIPHENYLS			
AROCLOR-1016	12674-11-2	3.4E+00	SSL
AROCLOR-1221	11104-28-2	3.7E-02	SSL
AROCLOR-1232	11141-16-5	3.3E-02	RDL
AROCLOR-1242	53469-21-9	1.1E-01	SSL
AROCLOR-1248	12672-29-6	1.7E+00	SSL
AROCLOR-1254	11097-69-1	6.7E-01	SSL
AROCLOR-1260	11096-82-5	9.8E-01	SSL
POLYNUCLEAR AROMATIC HYDROCARBONS			
ACENAPHTHENE	83-32-9	2.3E+02	SSL
ACENAPHTHYLENE	208-96-8	1.5E+03	SSL
ANTHRACENE	120-12-7	5.3E+03	SSL
BENZO(A)ANTHRACENE	56-55-3	2.4E+00	SSL
BENZO(A)PYRENE	50-32-8	4.7E-01	Cancer PRG
BENZO(B)FLUORANTHENE	205-99-2	4.7E+00	Cancer PRG
BENZO(G,H,I)PERYLENE	191-24-2	2.0E+01	SSL
BENZO(K)FLUORANTHENE	207-08-9	4.7E+02	Cancer PRG
CHRYSENE	218-01-9	2.4E+03	SSL
DIBENZ(A,H)ANTHRACENE	53-70-3	1.6E-01	Cancer PRG
FLUORANTHENE	206-44-0	6.3E+03	SSL
FLUORENE	86-73-7	2.4E+02	SSL
INDENO(1,2,3-CD)PYRENE	193-39-5	4.7E+00	Cancer PRG
NAPHTHALENE	91-20-3	2.0E+01	SSL
PHENANTHRENE	85-01-8	1.5E+03	SSL
PYRENE	129-00-0	1.5E+03	SSL
SEMI-VOLATILE ORGANIC COMPOUNDS			
1,2,4-TRICHLOROBENZENE	120-82-1	1.4E+01	SSL
1,2-DICHLOROBENZENE	95-50-1	3.5E+01	SSL
1,3-DICHLOROBENZENE	541-73-1	3.5E-01	SSL
1,4-DICHLOROBENZENE	106-46-7	3.3E-01	RDL
2,4,5-TRICHLOROPHENOL	95-95-4	3.0E+02	SSL
2,4,6-TRICHLOROPHENOL	88-06-2	3.3E-01	RDL
2,4-DICHLOROPHENOL	120-83-2	1.3E+00	SSL
2,4-DIMETHYLPHENOL	105-67-9	1.0E+01	SSL
2,4-DINITROPHENOL	51-28-5	1.6E+00	RDL
2,4-DINITROTOLUENE	121-14-2	7.2E-01	SSL
2,6-DINITROTOLUENE	606-20-2	3.3E-01	RDL
2-CHLORONAPHTHALENE	91-58-7	1.0E+02	SSL
2-CHLOROPHENOL	95-57-8	2.0E+00	SSL
2-METHYLNAPHTHALENE	91-57-6	2.0E+01	SSL
2-METHYLPHENOL	95-48-7	2.0E+01	SSL
2-NITROANILINE	88-74-4	1.6E+00	RDL
2-NITROPHENOL	88-75-5	2.2E+00	SSL
3,3'-DICHLOROBENZIDINE	91-94-1	1.6E+00	RDL
3-NITROANILINE	99-09-2	1.6E+00	RDL
4,6-DINITRO-2-METHYLPHENOL	534-52-1	1.6E+00	RDL

Table 1 (Page 2 of 3)
Soil Field Action Levels for Organic and Inorganic Chemicals

Boeing Reality Corporation, Former C-6 Facility

Chemical	CAS No.	Industrial Soil FAL (mg/kg)	Basis
4-BROMOPHENYLPHENYL ETHER	101-55-3	3.3E-01	RDL
4-CHLORO-3-METHYLPHENOL	59-50-7	2.0E+00	SSL
4-CHLOROANILINE	106-47-8	1.3E+00	SSL
4-CHLOROPHENYL-PHENYL ETHER	7005-72-3	3.3E-01	RDL
4-METHYLPHENOL	106-44-5	1.7E+00	SSL
4-NITROANILINE	100-01-6	1.6E+00	RDL
4-NITROPHENOL	100-02-7	2.2E+00	SSL
ANILINE	62-53-3	6.6E-01	RDL
BENZIDINE	92-87-5	6.6E-01	RDL
BENZOIC ACID	65-85-0	8.8E+02	SSL
BENZYL ALCOHOL	100-51-6	8.5E+01	SSL
BIS(2-CHLOROETHOXY)METHANE	111-91-1	3.3E-01	RDL
BIS(2-CHLOROETHYL)ETHER	111-44-4	3.3E-01	RDL
BIS(2-CHLOROISOPROPYL)ETHER	108-60-1	3.3E-01	RDL
BIS(2-ETHYLHEXYL)PHTHALATE	117-81-7	3.8E+01	Cancer PRG
BUTYLBENZYLPHTHALATE	85-68-7	9.0E+02	SSL
DIBENZOFURAN	132-64-9	2.3E+01	SSL
DIETHYLPHTHALATE	84-66-2	8.6E+04	SSL
DIMETHYPHTHALATE	131-4-3	3.3E-01	RDL
DI-N-BUTYLPHTHALATE	84-74-2	2.0E+03	SSL
DI-N-OCTYLPHTHALATE	117-84-0	5.9E+03	Noncancer PRG
HEXACHLOROBENZENE	118-74-1	3.3E-01	RDL
HEXACHLOROBUTADIENE	87-68-3	2.0E+00	SSL
HEXACHLOROCYCLOPENTADIENE	77-47-4	4.0E+02	SSL
HEXACHLOROETHANE	67-72-1	1.0E+00	SSL
ISOPHORONE	78-59-1	5.0E-01	SSL
NITROBENZENE	98-95-3	3.3E-01	RDL
N-NITROSODIMETHYLAMINE	62-75-9	3.3E-01	RDL
N-NITROSO-DI-N-PROPYLAMINE	621-64-7	3.3E-01	RDL
N-NITROSODIPHENYLAMINE	86-30-6	1.0E+00	SSL
PENTACHLOROPHENOL	87-86-5	1.6E+00	RDL
PHENOL	108-95-2	1.6E+02	SSL
VOLATILE ORGANIC COMPOUNDS			
1,1,1,2-TETRACHLOROETHANE	630-20-6	5.0E-03	RDL
1,1,1-TRICHLOROETHANE	71-55-6	1.8E+02	SSL
1,1,2,2-TETRACHLOROETHANE	79-34-5	5.0E-03	RDL
1,1,2-TRICHLOROETHANE	79-00-5	1.4E-02	SSL
1,1-DICHLOROETHANE	75-34-3	1.5E+01	SSL
1,1-DICHLOROETHENE	75-35-4	5.0E-03	RDL
1,1-DICHLOROPROPENE	563-58-6	5.0E-03	RDL
1,2,3-TRICHLOROBENZENE	87-61-6	1.4E+01	SSL
1,2,3-TRICHLOROPROPANE	96-18-4	5.0E-03	RDL
1,2,4-TRICHLOROBENZENE	120-82-1	1.4E+01	SSL
1,2,4-TRIMETHYLBENZENE	95-63-6	5.7E+01	Noncancer PRG
1,2-DIBROMO-3-CHLOROPROPANE	96-12-8	1.0E-02	RDL
1,2-DIBROMOETHANE	106-93-4	5.0E-03	RDL
1,2-DICHLOROBENZENE	95-50-1	3.5E+01	SSL
1,2-DICHLOROETHANE	107-06-2	5.0E-03	RDL
1,2-DICHLOROPROPANE	78-87-5	5.0E-03	RDL
1,3,5-TRIMETHYLBENZENE	108-67-8	2.3E+01	Noncancer PRG
1,3-DICHLOROBENZENE	541-73-1	3.5E-01	SSL
1,4-DICHLOROBENZENE	106-46-7	1.2E-02	SSL
1,4-DIOXANE	123-91-1	2.5E-01	RDL
2,2-DICHLOROPROPANE	594-20-7	5.0E-03	RDL
2-BUTANONE(MEK)	78-93-3	6.8E+01	SSL
2-CHLOROETHYLVINYL ETHER	110-75-8	1.0E-02	RDL
2-CHLOROTOLUENE	95-49-8	4.6E+00	SSL
2-HEXANONE	591-78-6	1.6E+01	SSL
2,2-DICHLOROPROPANE	594-20-7	5.0E-03	RDL
4-CHLOROTOLUENE	106-43-4	4.6E+00	SSL
4-METHYL-2-PENTANONE (MIBK)	108-10-1	1.6E+01	SSL
ACETONE	67-64-1	1.1E+01	SSL
ACETONITRILE	75-05-8	7.4E-01	SSL
ACROLEIN	107-02-8	1.1E-01	Noncancer PRG
ACRYLONITRILE	107-13-1	1.0E-01	RDL
BENZENE	71-43-2	1.3E-02	SSL
BROMOBENZENE	108-86-1	5.5E+00	SSL
BROMOCHLOROMETHANE	74-97-5	5.0E-03	RDL

Table 1 (Page 3 of 3)
Soil Field Action Levels for Organic and Inorganic Chemicals

Boeing Reality Corporation, Former C-6 Facility

Chemical	CAS No.	Industrial Soil FAL (mg/kg)	Basis
BROMODICHLOROMETHANE	75-27-4	5.0E-03	RDL
BROMOFORM	75-25-2	8.0E-01	SSL
BROMOMETHANE	74-83-9	1.8E-01	SSL
CARBON DISULFIDE	75-15-0	6.1E+00	Noncancer PRG
CARBON TETRACHLORIDE	56-23-5	5.0E-03	RDL
CHLOROBENZENE	108-90-7	5.5E+00	SSL
CHLOROETHANE	75-00-3	3.5E-02	SSL
CHLOROFORM	67-66-3	5.0E-03	RDL
CHLOROMETHANE	74-87-3	1.4E-02	SSL
CIS-1,2-DICHLOROETHENE	156-59-2	1.2E-01	SSL
CIS-1,3-DICHLOROPROPENE	10061-01-5	5.0E-03	RDL
DIBROMOCHLOROMETHANE	124-48-1	5.0E-03	RDL
DICHLORODIFLUOROMETHANE (Freon 12)	75-71-8	4.2E+01	SSL
ETHYLBENZENE	100-41-4	2.7E+01	SSL
HEXACHLOROBUTADIENE	87-68-3	5.7E-03	SSL
IODOMETHANE	74-88-4	1.0E-02	RDL
ISOPROPYLBENZENE	98-82-8	1.7E+02	Noncancer PRG
ISOPROPYL ETHER (DIPE)	108-20-3	4.1E+01	SSL
METHYLENE CHLORIDE	75-09-2	5.7E-02	SSL
METHYL-T-BUTYL ETHER (MTBE)	1634-04-4	4.1E+01	SSL
N-BUTYLBENZENE	104-51-8	2.2E+01	SSL
N-PROPYLBENZENE	103-65-1	2.2E+01	SSL
P-ISOPROPYL TOLUENE	99-87-6	5.3E+02	SSL
SEC-BUTYLBENZENE	135-9-88	1.7E+01	SSL
STYRENE	100-42-5	1.6E+02	SSL
T-BUTANOL	75-65-0	4.6E+01	SSL
T-BUTYLBENZENE	98-06-6	1.7E+01	SSL
TERT-AMYL METHYL ETHER (TAME)	994-05-8	4.1E+01	SSL
TERT-BUTYL ETHYL ETHER (ETBE)	637-92-3	4.1E+01	SSL
TETRACHLOROETHENE (PCE)	127-18-4	2.3E-02	SSL
TETRAHYDROFURAN	109-99-9	3.2E+02	Cancer PRG
TOLUENE	108-88-3	3.8E+01	SSL
TRANS-1,2-DICHLOROETHENE	156-60-5	3.0E+00	SSL
TRANS-1,3-DICHLOROPROPENE	10061-02-6	5.0E-03	RDL
TRICHLOROETHENE (TCE)	79-01-6	2.7E-02	SSL
TRICHLOROFLUOROMETHANE	75-69-4	6.8E+01	SSL
VINYL ACETATE	108-05-4	1.1E+02	SSL
VINYL CHLORIDE	75-01-4	1.0E-02	RDL
XYLENES (TOTAL)	1330-20-7	5.3E+02	SSL
OTHER CHEMICAL PARAMETERS			
PERCHLORATE	7601-90-3	5.0E-02	RDL
SODIUM CYANIDE	143-33-9	4.0E+01	SSL

Table 2

Soil Field Action Levels for Petroleum Hydrocarbon Mixtures

Boeing Reality Corporation Former C-6 Facility

Site Soil Type	Soil FAL (mg/kg)			
	Gasoline/ Naphtha	Kerosene/ JP-4	Diesel #2	Fuel Oil
Silty Sand	5.6E+03	7.8E+03	1.0E+04	1.4E+04

Appendix A

BOE-C6-0232102

APPENDIX A

PRELIMINARY MAXIMUM BACKGROUND METALS CONCENTRATIONS IN SOIL AND ASSOCIATED DATA GRAPHS

Preliminary Maximum Background Concentrations for the Former Boeing C-6 Facility and Southern California Background Levels.

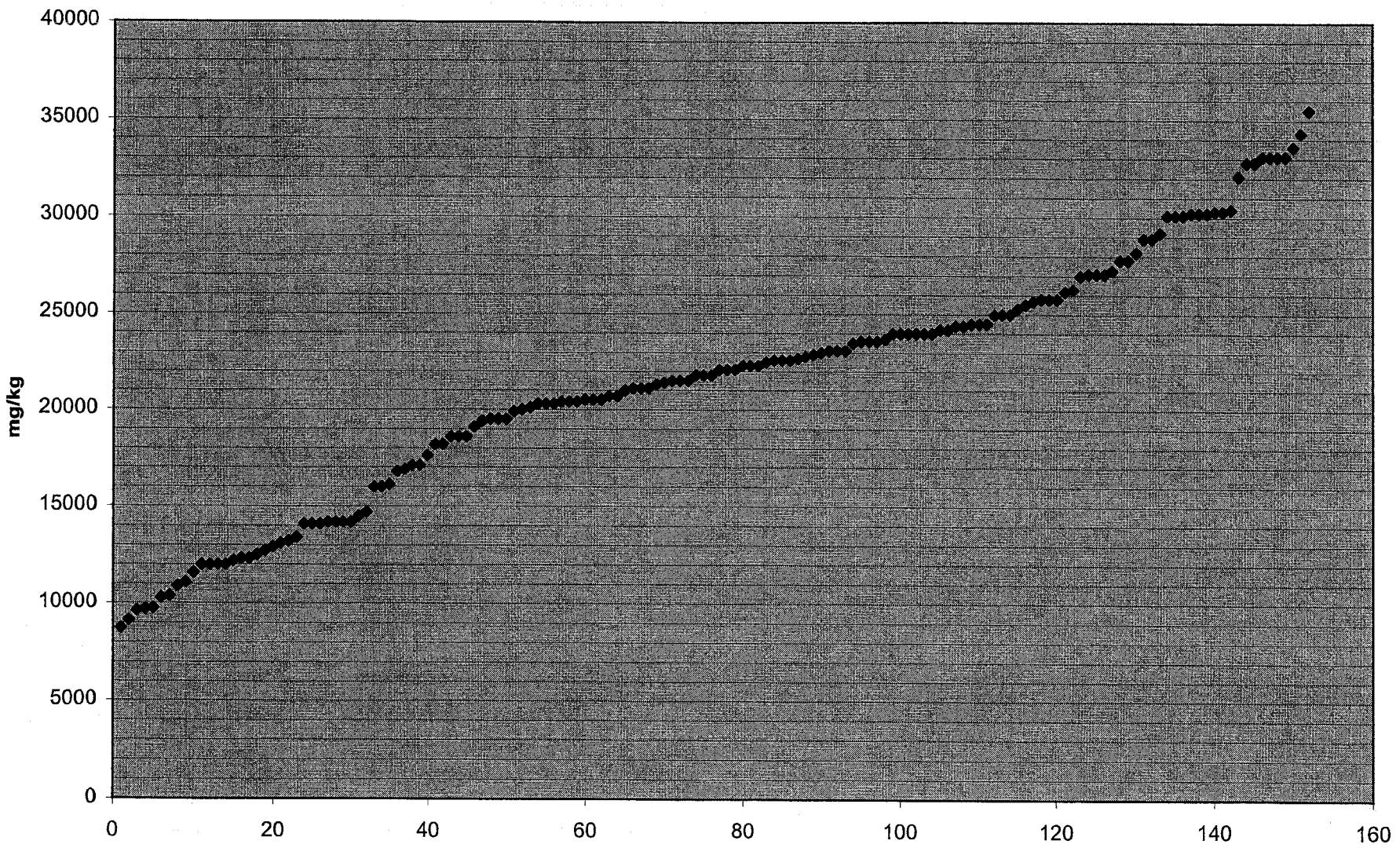
Metals Detected Onsite	*Background Value/ Proposed Screening Criteria (mg/kg)*	*Southern California Background [1] (mg/kg)*
Aluminum	27,000	NA
Antimony	1.9	0.12-1.9
Arsenic	8	1.8-15.2
Barium	135	23-560
Beryllium	<0.5	<0.1-1.2
Cadmium	<0.5	0.05-1.45
Chromium (VI)	<0.5	NA
Chromium Total	39	5.8-32.6
Cobalt	9.4	1.6-23.2
Copper	20	3.8-54
Lead	8	2.5-189.4
Mercury	<0.1	0.1-0.6
Molybdenum	<1	0.15-1.4
Nickel	18	3.5-28.2
Selenium	0.43	0.015-0.43[2]
Silver	<0.5	0.07-0.75
Thallium	<5	0.05-35
Vanadium	38	18-84.8
Zinc	64	10.3-247

[1] Cal-EPA. 1992. Background Levels of Trace Elements in Southern California Soils, Draft Annual Report, California Environmental Protection Agency, Contract No. 89-T0081 by University of California, Riverside, California, June 1992 (composite sample for various depths).

[2] Kearney Foundation. 1996. Background Concentrations of Trace and Major Elements in California Soils, Kearney Foundation of Soil Science, Division of Agriculture and Natural Resources, University of California

NA = Not Available

Aluminum Concentrations



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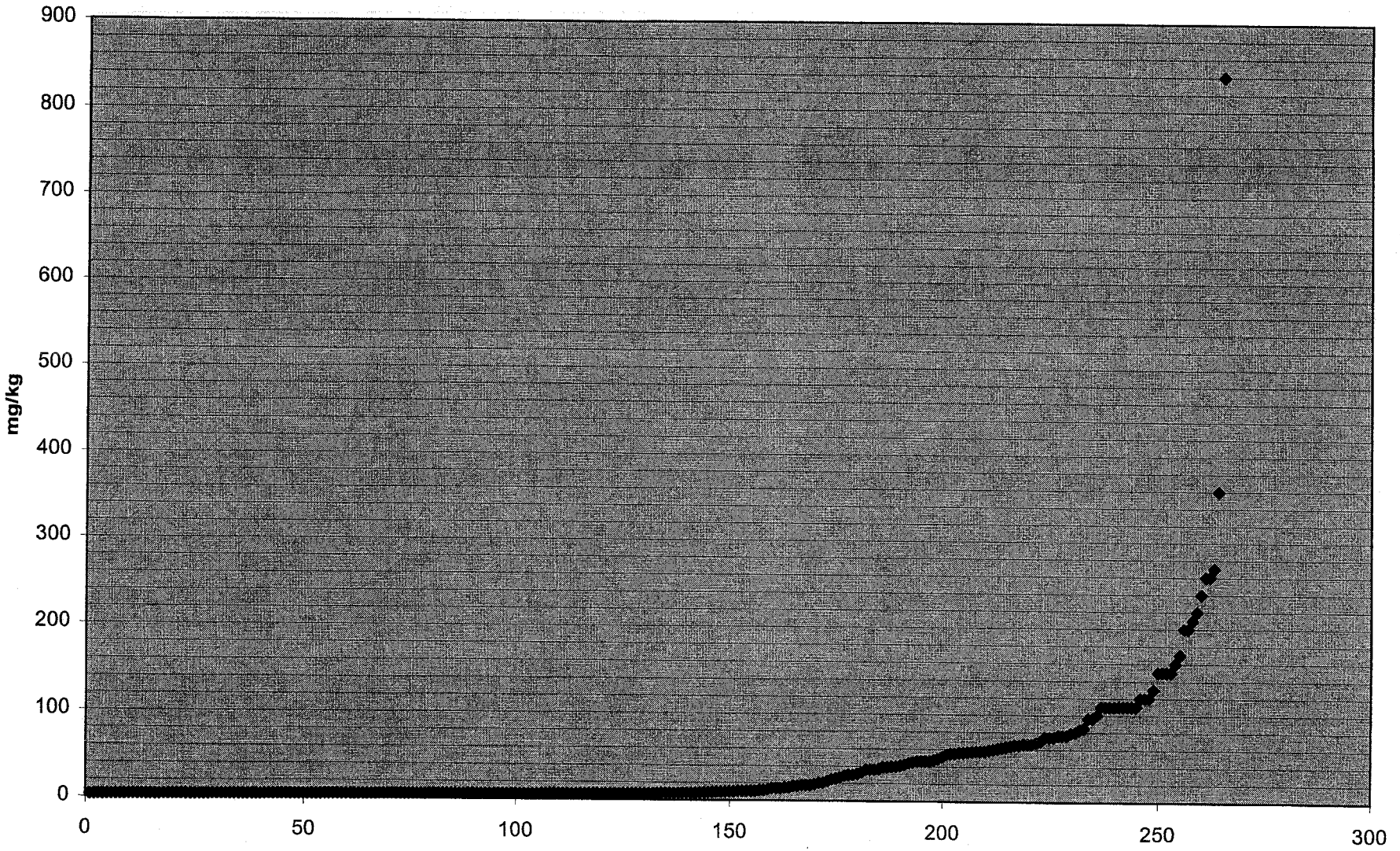
Arsenic Concentrations



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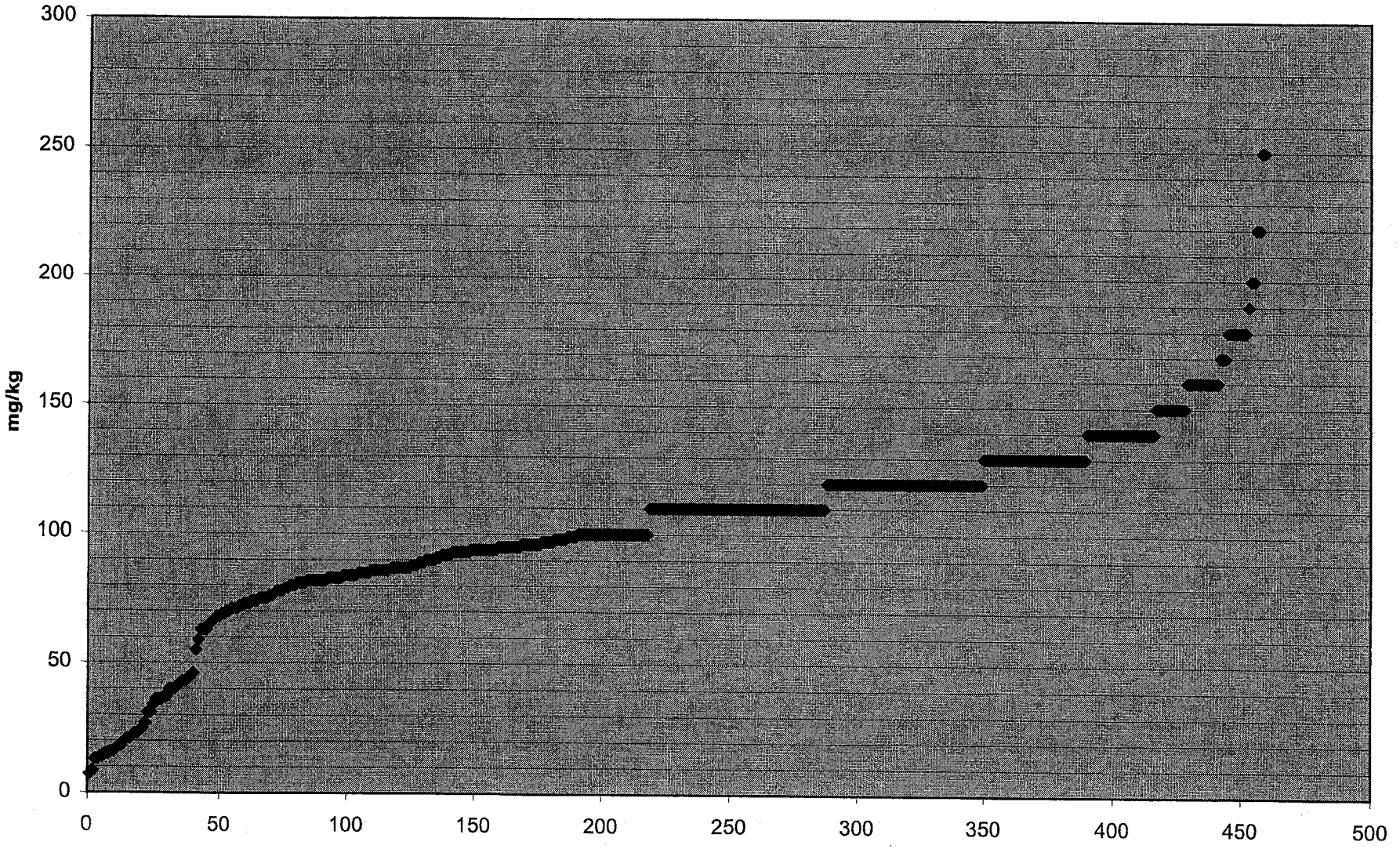
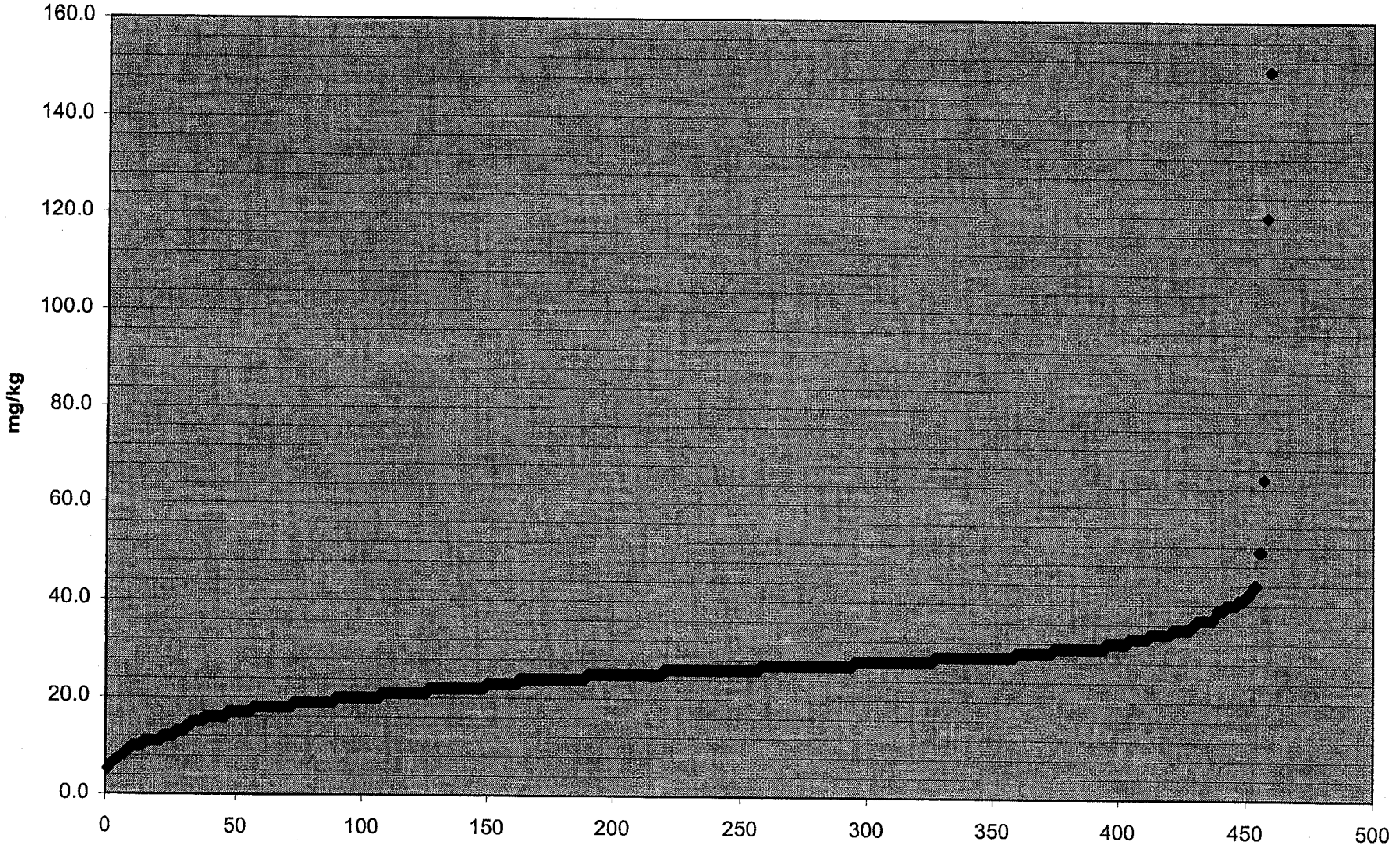
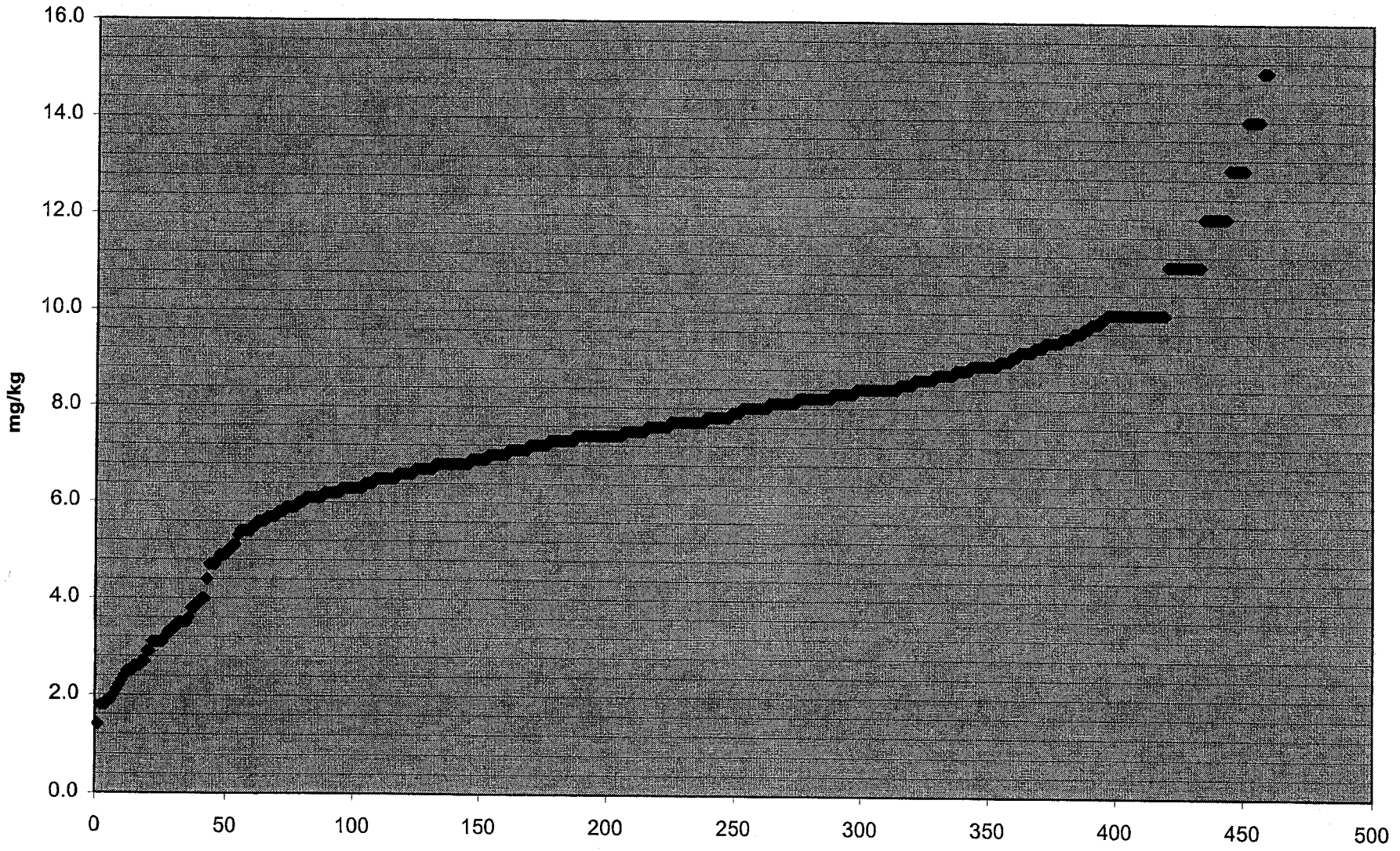
Barium Concentrations



Total Chromium Concentrations



Cobalt Concentrations



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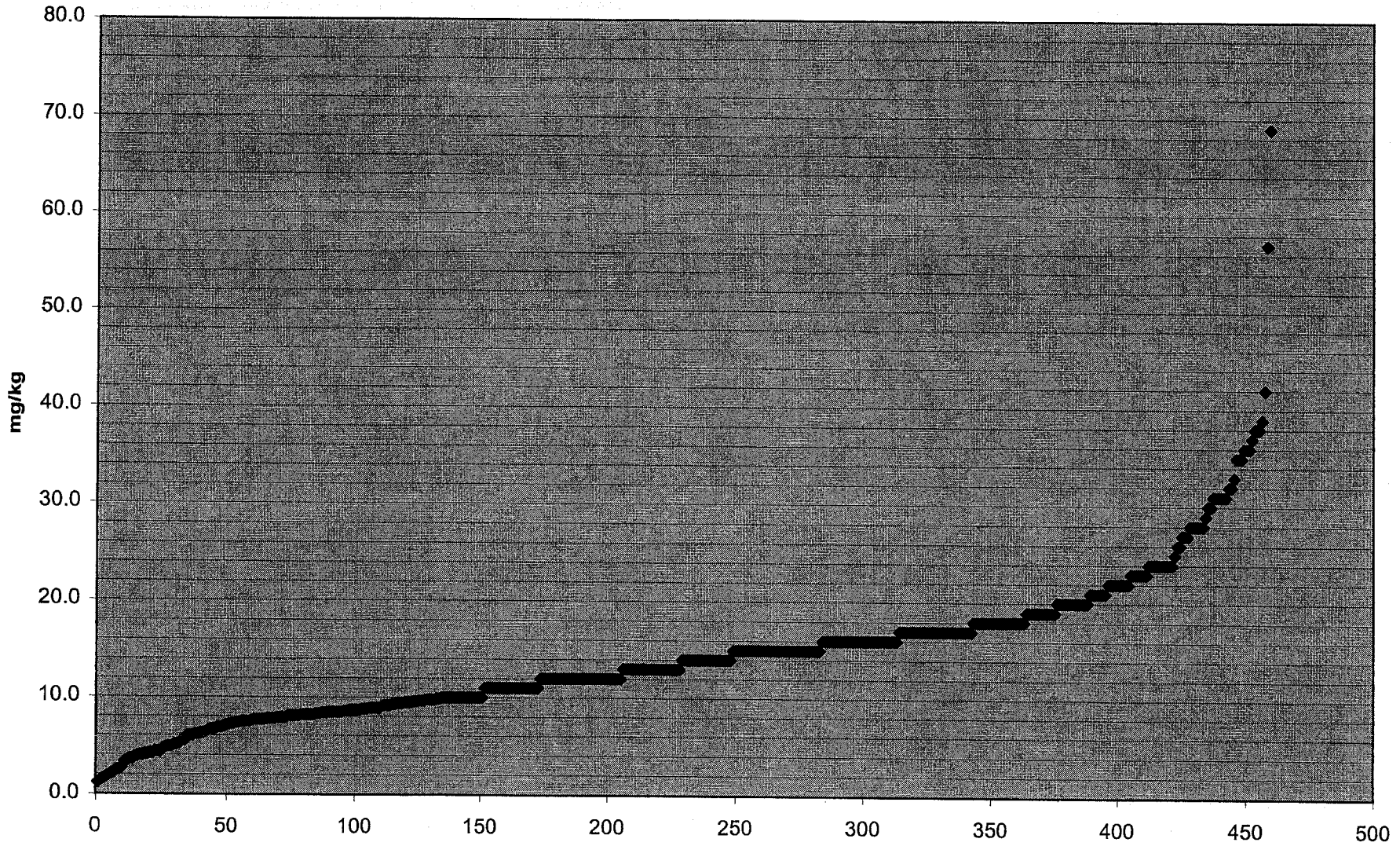
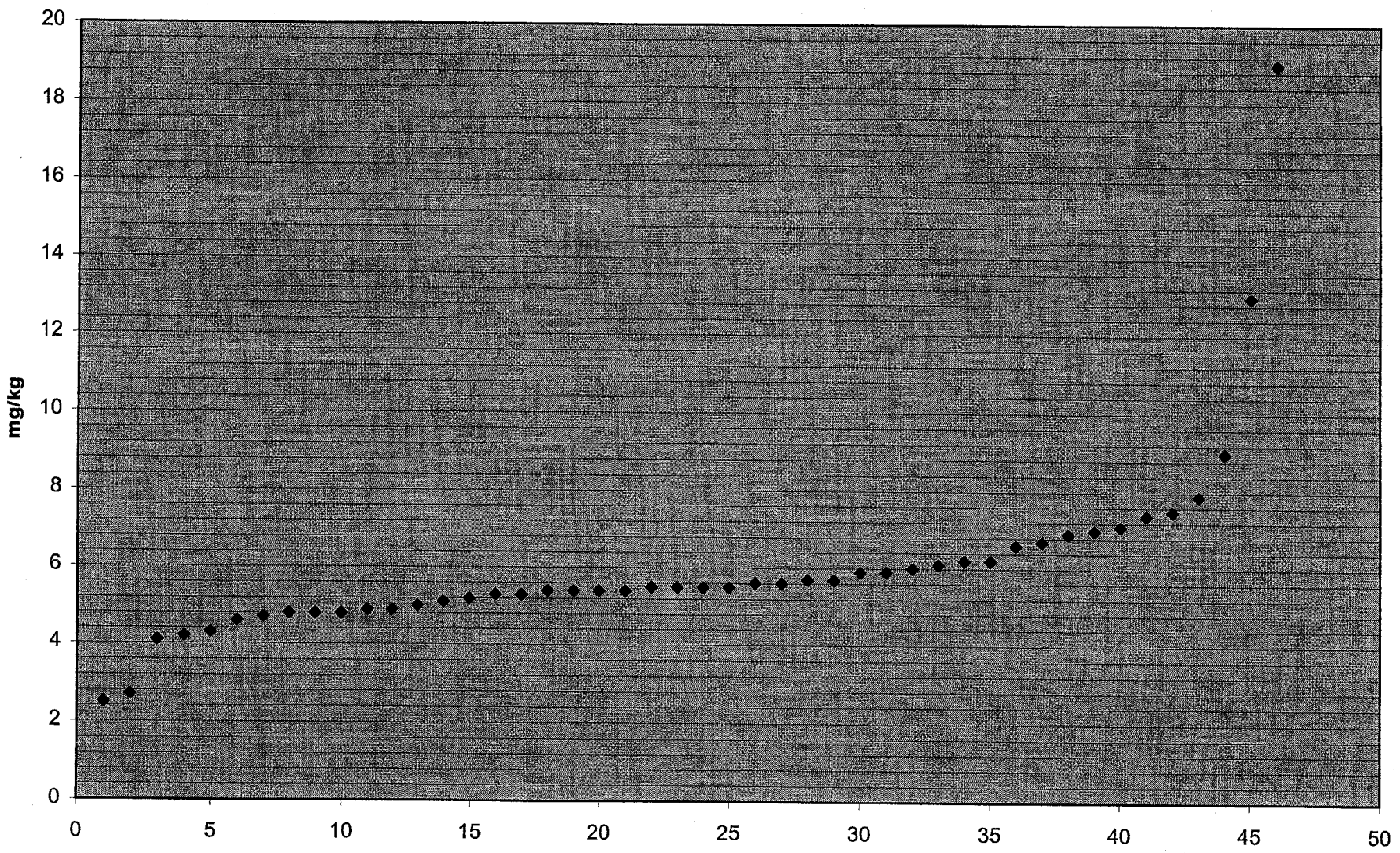
Copper Concentrations



Lead Concentrations



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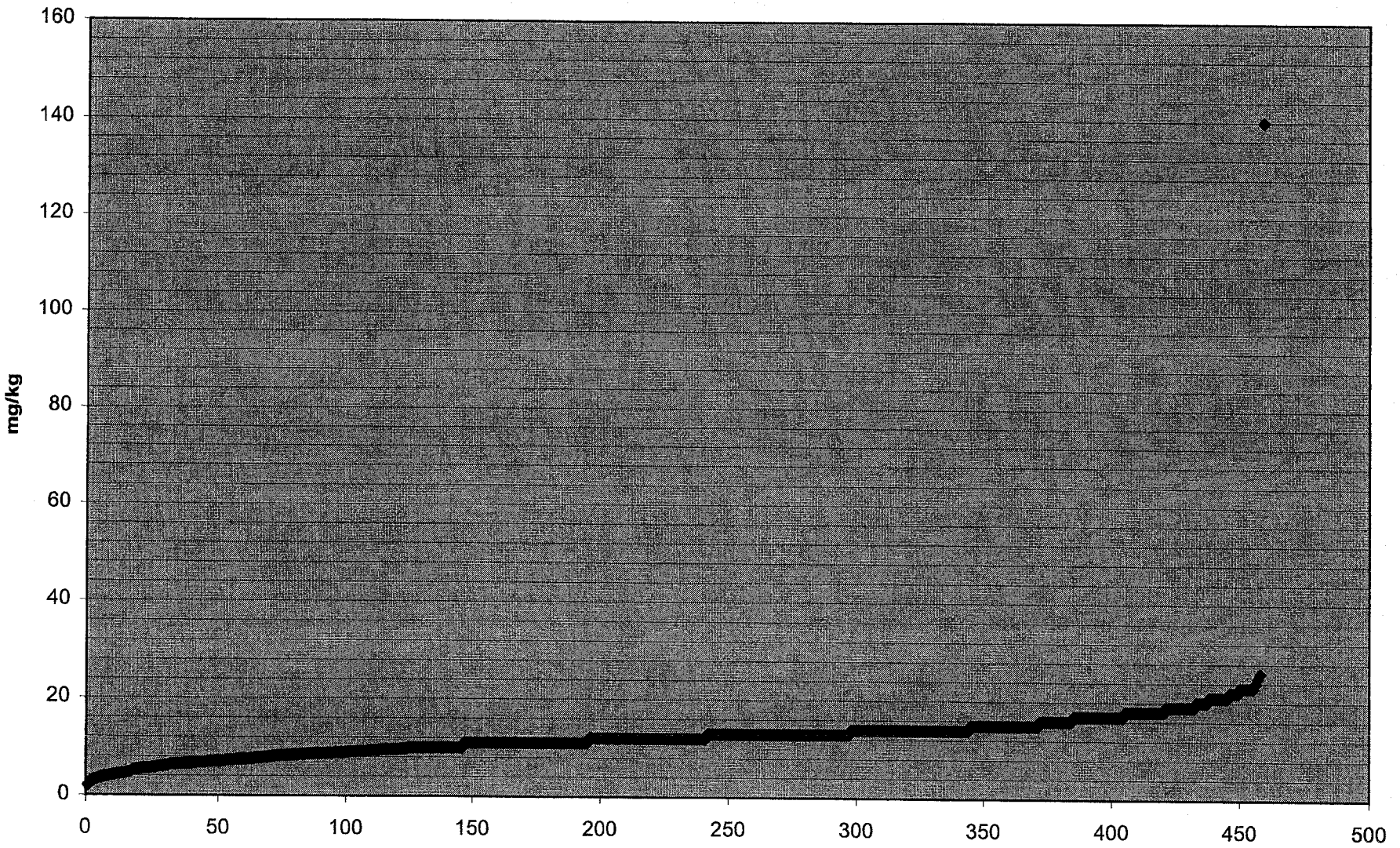
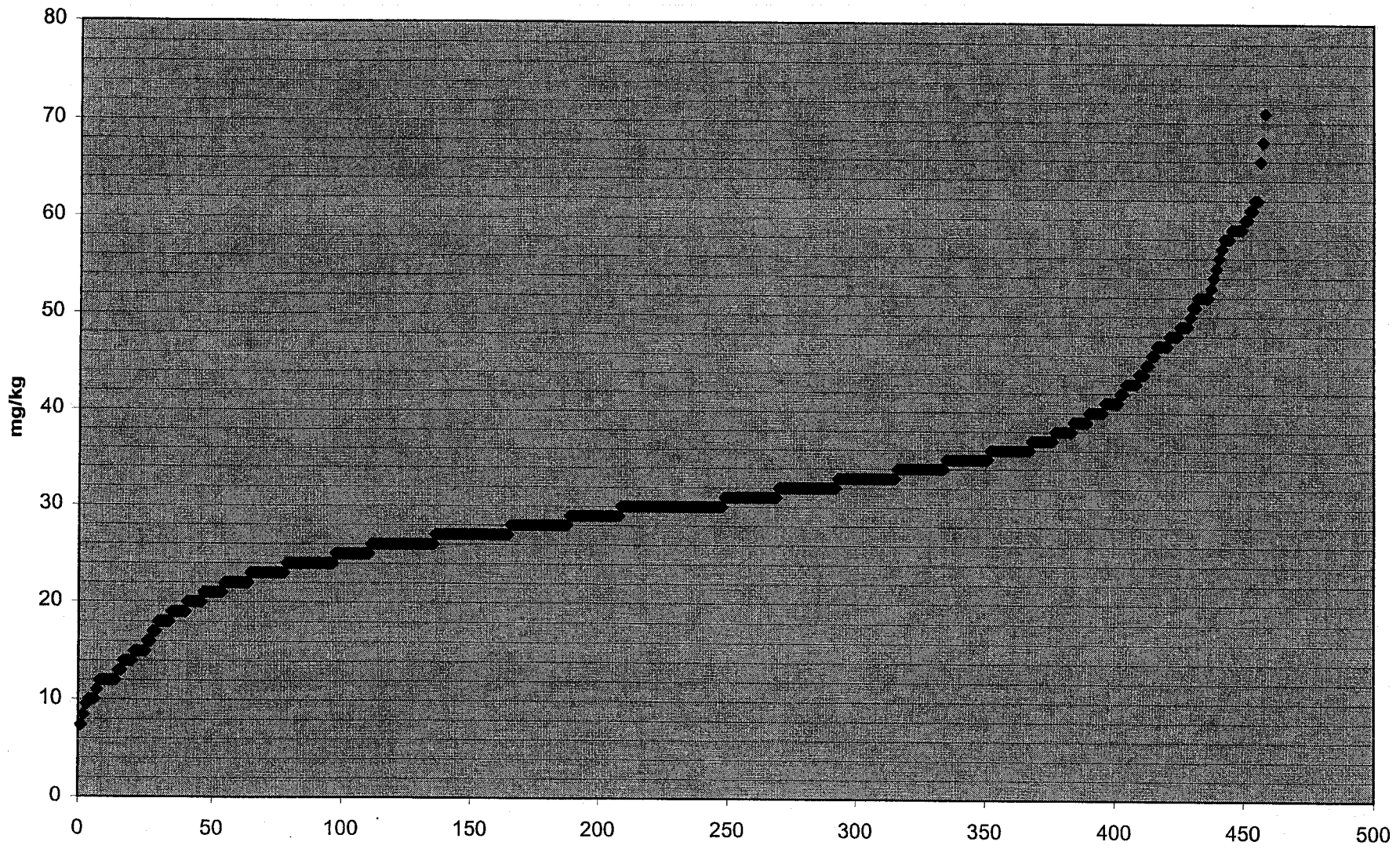
Nickel Concentrations



Vanadium Concentrations



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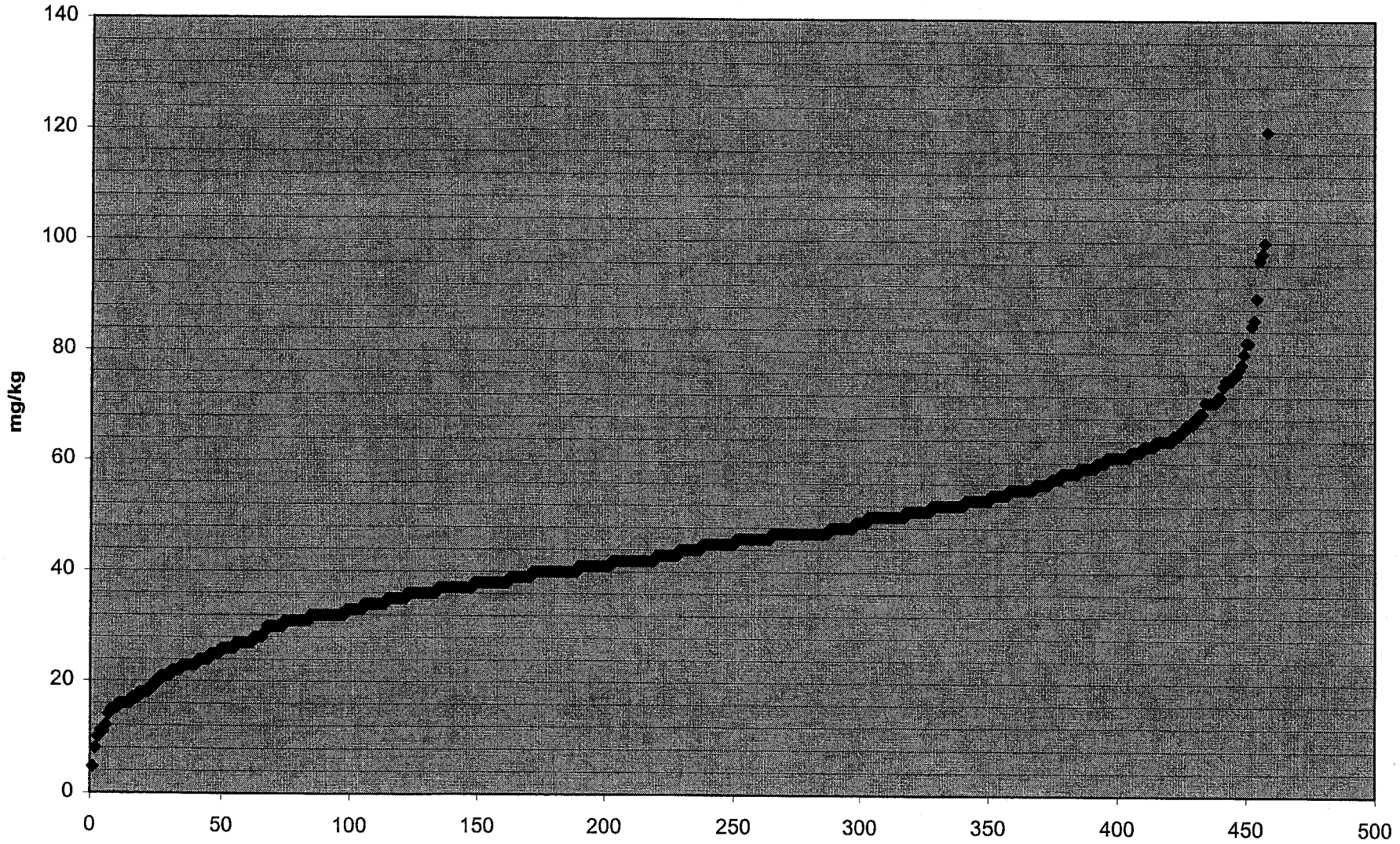
Zinc Concentrations



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